



Waihi Growth Areas (W2, W4, W6 and W7)

Transportation Assessment

Prepared for
Hauraki District Council

Prepared by
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Executive summary

This report is a 2023 update to the original report written in 2019 to account for changes in intent with regard to lot areas. Since submission of the 2019 report, several changes to the Proposed Plan Change 2: Waihi Rezoning necessitated a third revision of the report, including reducing the area extent of W2, removal of area W3 and the addition of a low-density residential area (W7) located just west of W6. As this is a report update, the analysis reflected in this report still uses 2019 as the baseline year.

Growth areas W2, W4, W6 and W7, all in the Waihi area of Hauraki District, were assessed for both the existing and potential future statuses of the transport network.

Considerations were as follows:

- Existing nature of the roads and other transport facilities around each growth area, including safety considerations.
- Crash history for the existing roads, including a comparison against Waka Kotahi – NZ Transport Agency (NZTA) Crash Prediction Modelling.
- Likely attractors for travel and resulting travel patterns.
- Network assessment using the principles of ‘Gravity Modelling’ for those travel patterns in various scenarios from Existing to a predicted 2035 2% per annum increase plus High Development of the growth areas (anticipating future subdivision).
- Intersection modelling for key locations based on the assessed trip distribution.
- A comparison of the worst-case future Crash Prediction Model with the existing situation.

Taking all these factors, including results of modelling exercises into account, the following conclusions and recommendations were reached. For reference, a set of Figures showing indicative growth area boundaries and road layouts can be found in Appendix A.

Growth Area W2: Waihi Beach Road and Ford Road Conclusions and Recommendations:

Note: W2 revised in August 2024.

On revisiting traffic figures, it was discovered that traffic volumes on State Highway 2 have decreased from our assumed Base year (refer assumptions below), as has the HCV proportion (figures from December 2023). This could be for a variety of reasons, and worth noting the Covid-19 pandemic occurred between the two sampled dates.

Due to this we have changed the nomenclature of the modelling intervals from “real” numbered years to hypothetical “BaseX” years. Based on an assumed 2% growth (in face of negative growth up to this point), it will take until 2030 to fully recover traffic volumes to our assumed Base year level (7,635); for this reason it will be important to keep a reasonable track of traffic growth on both roads as the development progresses (refer section 2.6 Recommendations).

For the purposes of this assessment, the Base year is considered to be the year at which development begins; all subsequent iterations are labelled by number of years after this point (so “Base1” is 1 year following start of development).

This area of the network is experiencing high traffic demand, which is impacting on the levels of service at the relatively minor Ford Road/State Highway 2 (SH2) intersection and may be contributing to some of the injury crashes reported in CAS.

Development of this area will increase this pressure, even with the alterations already implemented at this intersection, and for the *Option i* (Ford Road access), the levels of service on the Ford Street

approach to SH2 (although acceptable in the Base year with a Low Development scenario) are expected to be poor with a high industrial development scenario in 2035. The 2035 PM peak levels of service are similarly poor on the SH2 northern approach.

Through further modelling to determine capacity trigger points, it was determined that intersection capacity would be exceeded as follows:

Table 1.1: Intersection capacity exceeded

Capacity Exceeded Scenario	Ford Road (veh/day)		State Highway Traffic (veh/day)
	Standard traffic growth	Development traffic	
Base24 (2%)	410	0	12,800
Base9 + LD	320	2,400	11,200
Base1 + HD	270	3,600	10,700

Note: State Highway figures rounded to nearest 100

It is important to note, however, that the ability of the intersection to function is interdependent, and worst performing lanes observed in the modelling regardless of exact vehicle numbers are for right turns out of or into Ford Road (refer modelling outputs in Appendix C), all other lanes seem to operate acceptably. This suggests the key governing factor is the ability of motorists to find an acceptable gap in the State Highway traffic.

For *Option ii* (SH2 Roundabout access), the access provides a more direct and safe entry onto SH2 with good levels of service for all development scenarios and horizons. It also takes away the inherent issues with gap-acceptance in a high-speed environment

Given the impacts of the additional traffic introduced on the network by the W6 and W7 growth areas surrounding the State Highway 2 and Kenny Street intersection, this could lead to undesirable northbound SH2 traffic from W2 redistributing through residential neighbourhoods.

It is recommended site verification, namely traffic counting and turning counts, is carried out before the development of the site to better understand existing traffic volumes around this growth area, and exactly when peak flows occur.

Staging of the growth area should be linked to consideration of the expected traffic generation of individual activities and developments, with reference back to the original models to confirm that the overall traffic impacts are not significantly greater than current assumptions.

It may be appropriate during the development of the Structure Plan to consider different scenarios for speed limits, improvements to the major intersections, and heavy vehicle restrictions. Impact assessments from individual developers may aid HDC in assessing these outcomes going forward.

From the transport assessment undertaken, it is recommended considering a dedicated roundabout intersection for this area combined with the Waihi Beach Road intersection on SH2 prior to the Base9 scenario (2,400 veh/day generated by the development) when the State Highway 2 and Ford Road intersection appears to no longer have the capacity to handle the traffic volume growth and Low Development levels of traffic generation coming from Ford Road. Any proposal that increases demand on the State Highway intersection would need to take account of the requirements of the NZTA as follows below.

Allowing for the time to consent, design and build a roundabout, a “start planning” trigger should be considered if a roundabout is adopted as the preferred solution long-term. This has been estimated as the traffic volumes generated by the development three years prior to those in the Base9 scenario. Assuming linear progression from Base to Base 9 this would mean the “start planning” trigger would be when the development is contributing 1,600 veh/day.

It will also be important to monitor traffic volumes along Ford Road and the State Highway as development progresses to ensure the underlying traffic growth figures are not out of step with those presented in Table 2.16.

Growth Area W4: Waitete Road Conclusions and Recommendations:

The existing injury crash rate on Orchard Road is higher than is predicted by models from the NZTA guidelines. However, whilst the proportional increase seems significant, the starting level is lower than is measurable with the current data available, and a wider search indicates that only one injury crash is recorded for this road in the CAS database of approximately 40 years’ worth of data.

Due to the low expected trip generation numbers, even in a higher density development scenario, and the number of options for traffic disbursement into the local road network before accessing a major road, modelling was considered un-necessary as the effects are likely to be unmeasurable in any one location. Whilst some safety concerns have been raised with regards the existing local roads in the vicinity of the new growth area W4, there is no recorded accident history to suggest there is currently an issue.

The expected traffic growth from this area is not anticipated to noticeably change this. Recommendations have been made to extend footpaths and road seal; however, these are primarily for amenity, and resident ‘perception of safety’ only, and the demand for them is not expected to change solely due to this development.

Growth Area W6 and W7: Bradford Street Conclusions and Recommendations:

The predicted injury rates along affected roads are not expected to increase significantly apart from along Bradford Street. The intersection between Kenny Street and SH2, as well as the potential impacts of both W2 and W6 and W7 growth areas are expected to put pressure on these two intersections. The net effect is likely to increase demands at other intersections at various points along the main roads as traffic re-routes away from the more severely affected areas.

In the short term, the results indicate that the Kenny Street leg of the intersection experiences significant delay during peak hours at current traffic volumes plus the new development, with the SH2 right-turn lane into Kenny Street showing poor LoS metrics by 2048 with or without the new development.

It is recommended traffic and safety are monitored during development of the Structure Plan with particular emphasis on traffic volumes around the SH2/Kenny Street intersection to determine the peak hour conditions.

Further modelling, and/or refining of the existing models, should be undertaken to confirm the poor levels of service identified in this report should the W6 and W7 growth areas fully develop, taking into account potential route redistribution motorists would initially consider towards avoiding the intersection.

Summary:

We consider that the impact of W4 on the existing network will be negligible in terms of safety, efficiency and levels of service. Growth areas W6, W7 and W2 will need more detailed consideration due to the likelihood of the traffic generated affecting adjacent roads and intersections in particular

the affect existing traffic is already having on State Highway connections needs to be established. It should be noted that whilst we have attempted a localised assessment of interactions between growth areas where obvious, the compounding effect of all these growth areas being developed concurrently have not been fully assessed.

1 Introduction

Tonkin & Taylor Ltd (T+T) have been engaged by Hauraki District Council (HDC) to undertake a revision to the original Feb 2020 high-level transportation report that assessed the future W2, W3, W4 and W6 growth areas in Waihi. Since submission of that report, several changes to the Proposed Plan Change 2: Waihi rezoning has necessitated a third revision of the report. These changes include the following:

- Area W2 – Ford Road (Rural to Industrial): the extent of this area was reduced due to the National Policy Statement on Highly Productive Land condition limiting land requirements to cater for 10 years of growth only.
- Area W3 – Reservoir/Wharry Road (Rural to Residential): this area is no longer being considered in the short term due to significant 3 Waters (wastewater) issues.
- Area W7 – Bradford Street Extension: this is a new area to the west of W6 (Low Density Residential, to stay Low Density Residential with amended development standards). Impacts of the W7 addition has been incorporated into the W6: Bradford Street section of the original report.

The growth areas, identified as W2, W4, W6 and W7, are roughly indicated in Figure 1.1 below, and on plans in Appendix A.

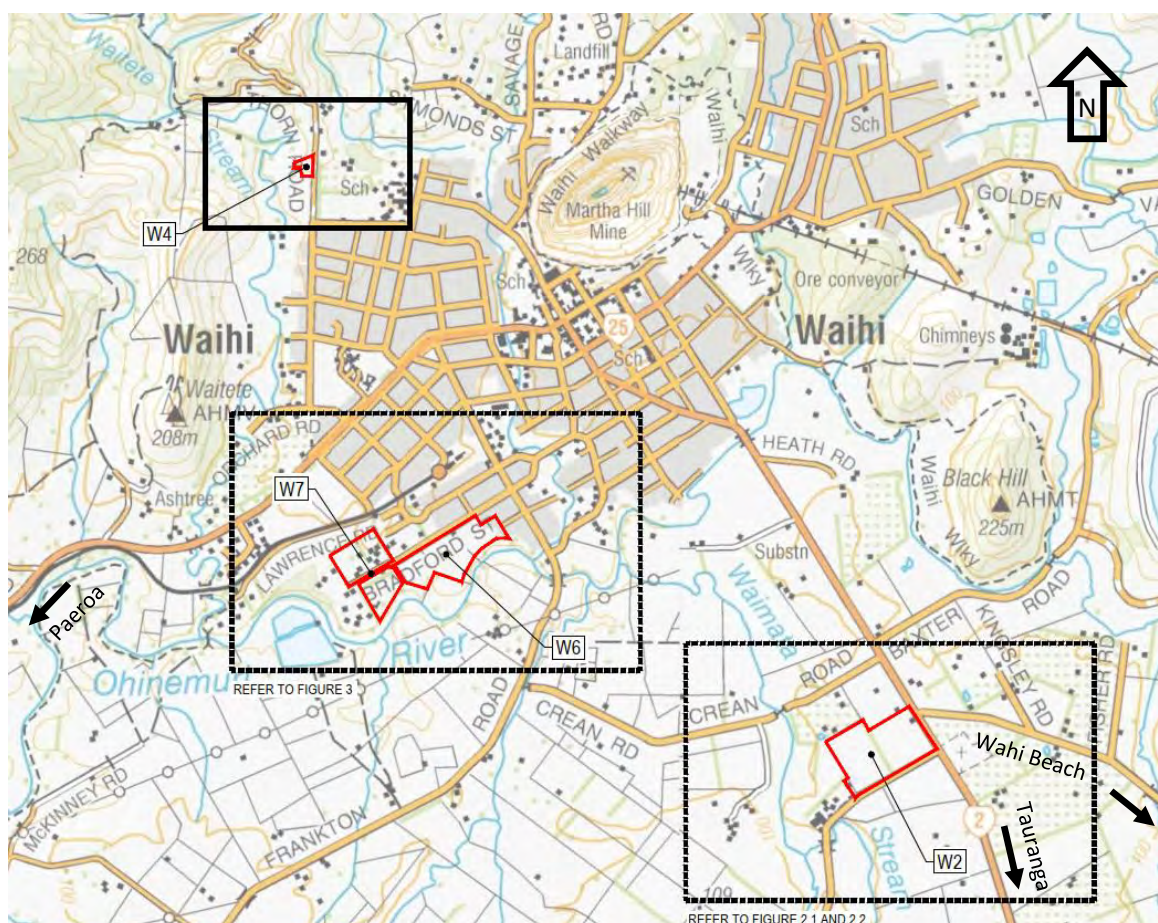


Figure 1.1: Waihi Future Growth Areas (Outlines approximate).

Each of the growth areas are assessed in separate sections of this report, ordered numerically from W2 in section 2, W4 in section 3 and W6 & W7 combined in section 4.

The assessments consist of:

- Collation of existing traffic data on the surrounding roads and environment for each zone.
- Development of broad assumptions with regards traffic growth, trip generation, traffic mix, and trip distribution, using readily available information.
- Development of conceptual-level primary road layouts within the growth areas.
- A general assessment of the potential impacts an increase in traffic may have on the adjacent roading network.
- A high-level assessment of the safety implications on the existing network.
- Development of high-level intersection models in SIDRA 8 for the key areas of potential concern.

This assessment then informs concluding remarks and recommendations for next steps.

As this is an update to the original report written in 2019, intended to account for different changes in intent with regards to lot areas and areas proposed to be rezoned, the update still uses 2019 as the baseline year for all analysis.

2 Waihi: W2 – Ford Road

2.1 Growth Area

The W2 growth area shown in Figure 2.1 comprises some 11.7 ha of land to the south of Waihi and abuts to the north of Ford Road and is currently zoned Rural. Figure 1 in Appendix A shows the location of the W2 growth area within the greater Waihi District. This land is proposed for industrial subdivision and development, as opposed to the other three areas (W3, W6 and W7) in this report, which remain as residential.



Figure 2.1: Approximate extent of W2 growth area (image sourced from Google Earth).

2.2 Existing Situation

2.2.1 Transport Environment

The roads bordering growth area W2 are State Highway 2 (SH2) to the east, linking through to Victoria Street in Waihi, and Ford Road to the south designated as a Collector Road in the Hauraki District Plan¹. The main link to the wider network is SH2. These roads are all consistent with a rural environment.

Any traffic wanting to head north or south can access SH2 via Ford Road. No footpaths or dedicated cycling facilities are provided in the vicinity of this proposed growth area.

Table 2.1: Road Details (Existing)

Road Name	Total Lane Width (m)	Lanes	Shoulder	Cycle Facilities	Footpaths	Posted Speed (km/h)
Waihi Beach Road	7.0 to 8.0	2	None	None	None	100
Ford Road	5.8	2	None	None	None	100
State Highway 2	7.2	2	2x 2.5 m approx.	None specifically provided	None	100

Note: Measurements are approximate only using Google Earth.

The following features were installed on State Highway 2 in early 2019:

- Painted median markings, approximately 3.0 m wide.
- Right Turn Bays within the median for Crean and Ford Roads.
- Short left slip-lane from the State Highway onto Crean and Ford Roads, approximately 2.0 to 2.5 m wide.
- Widened shoulders between Crean and Ford Roads (western side of the State Highway) with barrier installations progressing.

No on-site measurements were taken, but approximations based on minimum standards were used in the modelling of the intersections, also noted above.

2.2.2 Crash History

The NZTA Crash Analysis System (CAS) was interrogated for the period 2009 to 2019 (inclusive) to provide crash data for the roads in the immediate vicinity of the development and the closest key State Highway intersection. Full CAS outputs including crash diagrams can be found in Appendix B.

Table 2.2: Historical Crash Numbers

Road Name	Number of Crashes	Non-injury	Minor Injury (M)	Death or Serious (DSI)	Crash Injury Rate	Years
Ford Road	1	0	0	1	0.1	1x 2017 (DSI)
State Highway 2 (total)	21	12	6	3	0.9	5x 2018 (2x M) 1x 2017 3x 2016 (1x M) 2x 2015

¹ Hauraki District Plan, Hauraki District Council. September 2014, Map L1

Road Name	Number of Crashes	Non-injury	Minor Injury (M)	Death or Serious (DSI)	Crash Injury Rate	Years
						1x 2013 (1x M) 1x 2012 5x 2011 (3x DSI, 1x M)) 1x 2010 2x 2009 (1x M)
- SH2, Waihi Beach Rd Intersection	4	3	1	0	0.1	1x2018 1x2012 1x2011 (M) 1x2010
- SH2, Ford Intersection	3	1	1	1	0.2	1x 2016 1x 2013 (M) 1x 2011 (DSI)

This section of State Highway 2 has 21 accidents, many resulting in injuries, spread over the 10-year period. The SH2 intersections with Waihi Beach Road (with 4 crashes) and Ford Road (with 3 crashes) have relatively few crashes by comparison, with the full extent of Ford Road having only one crash recorded.

Note that the median and left slip lanes of the current configuration of State Highway 2 with Crean and Ford Roads (described in section 2.2.1) were upgraded early in 2019, and so all listed accidents on State Highway 2 identified in Table 2.2 therefore occurred prior to that work finishing.

2.2.3 Crash Prediction Modelling

A high-level Crash Prediction Model was put together for the existing situation at the State Highway 2 intersections with Waihi Beach and Ford Roads, and for Waihi Beach Road and Ford Road themselves, using the methods and formulae found in NZTA's Crash Estimation Compendium (2016, Updated June 2019).

State Highway 2 was assessed under the intersection product of flow (exposure) method for both its intersection with Waihi Beach Road and Ford Road, as they may both be affected by the development. All other roads were assessed under the mid-block only formula.

Table 2.3: Crash Model Results (Existing)

Road Name	Predicted Injury Crash Rate (existing)	Actual Injury Crash Rate	Differential: Predicted to Actual	Differential Rate
Ford Road (mid block)	0.025	0.1	+0.075	+300%
SH2, Waihi Beach Rd Intersection	0.38	0.1	-0.28	-73%
SH2, Ford Intersection	0.046	0.2	+0.154	+435%

Ford Road and the intersection of Ford Road with State Highway 2 have a significantly higher rate than predicted, however this could be due to the fact the rates predicted lie outside the normal frame of reference (10-year crash period, versus a prediction of 1 every 22 years for the Ford Road/State Highway 2 intersection, for example).

The median right-turn lanes implemented by NZTA in 2019 on SH2 at Ford and Crean Roads is however expected to improve overall junction safety and likely to reduce the crash rate statistic post 2019.

2.2.4 Road Safety

The existing road network around W2 is rural in nature. Generally, the road network, both local and State Highway, has no specific provision for pedestrians or cyclists.

2.2.5 Travel Patterns

No traffic survey has been undertaken, however using industry accepted practice in lieu of count or observation data, and existing data from the Road Assessment and Maintenance Management database (RAMM) we can infer likely peak travel patterns.

This data was extracted from Mobileroad.org, which is populated using Road Controlling Authority (RCA) RAMM² data. It was noted that while the State Highway traffic data is based on recent counts (June 2021), the HDC roads were all identified as estimates from 2011 and 2019, so we are unsure as to the accuracy of the data for that part of the network.

Spreadsheet count data was provided by HDC, however these counts dated from prior to the estimates on the Mobileroad.org website and so were considered likely to be out of date for the purposes of this assessment.

The key RAMM data used in this assessment is as follows:

Table 2.4: RAMM Data

Road Name	Average Daily Traffic (ADT) (veh/day)	Date of Count / Estimate	Heavy Vehicles (%)
Ford Road	257	13/02/2019	5%
SH2, (Waihi Beach Road Intersection)	4,450	30/06/2021	4%
SH2, (Ford Road Intersection)	7,635	25/12/2018	14.054%

Note: All data obtained from MobileRoad.org, all 2-way traffic.

The attractors for determining travel patterns are considered to be as follows:

Table 2.5: Attractors and Type

Location	Approximate Distance from W6	Attractor Type	Attractions
Waihi Town Centre	2.5 km	Local Primary Attractor	- Closest source of labour - Closest service town for ancillary businesses - Key link town between Bay of Plenty, Waikato and Coromandel Peninsula
Paeroa	23 km	Primary Attractor	Next closest source of labour and ancillary services after Waihi

² The "Road Assessment and Maintenance Management" system. This data is maintained by RCAs (usually NZTA and Local authorities) for tracking and forecasting maintenance activities on their respective networks.

Location	Approximate Distance from W6	Attractor Type	Attractions
			Route to wider Waikato and on to Auckland – both of these being major origin / destinations for materials and goods.
Tauranga	54 km	Primary Attractor	- Closest city, origin / destination for goods - Port city - Route to wider Bay of Plenty and on to Gisborne
Waihi Beach	8 km	Secondary Attractor	Smaller potential source of labour
Coromandel peninsula destinations (Whangamata)	25 km plus	Secondary Attractor	Origin / destinations for goods and materials
Local Rural Areas	<1 km plus	Secondary Attractor	- Origin / destinations for goods and materials - Servicing area for various industries

From these assumptions we can reasonably assume that the majority of commuter traffic will arrive from the north, from Waihi and beyond along the State Highway, returning from the same direction in a similar proportion.

The majority of heavy traffic generated by and attracted to the site will be north-west towards Paeroa and beyond, south towards Tauranga, and to a lesser extent north-east towards Whangamata.

If the road connections and bylaws remain unaltered, heavy through-traffic is likely to avoid Waihi town centre in favour of using Crean Road and Victoria Street to head north-west, and the Victoria Street to Crean Road intersection to head south.

2.2.6 Public Transport

According to the “Baybus.co.nz” website, State Highway 2 up to the Waihi Beach Road intersection is the route for the number 85 “Town Connector”. The nearest existing stop is available from Waihi town centre some 2.5 km away, servicing Waihi Beach and on to Katikati, linking up with a connector route to Tauranga city.

2.2.7 Other Modes

Realistically, the majority of trips in this area are likely to be private vehicle based due to the location of this growth area; a significant proportion of these will be heavy vehicles due to the nature of the intended land use.

There is the possibility that some locally based employees may choose to cycle to their place of work in this area, but it is not expected to be the norm.

2.3 Proposed Situation

The proposed W2 development area (shown in Figure 2.2) is intended to be used for industrial activities, as per the Hauraki District Plan³. Figure 2.2 *Option i* shows the option of an exclusive

³ Hauraki District Plan, Hauraki District Council, September 2014, section 5.12

development access road option off Ford Rd and Figure 2.2 *Option ii* shows an alternative (but more direct access option) onto SH2 via a proposed new roundabout incorporating Waihi Beach Road.

The provided Plan Change 2⁴ document provides no estimate of lots or traffic generation, however using NZTA's Planning Policy Manual⁵, an estimated generation between 0.2 and 0.3 veh/hr peak generation per 100 m² of site area is expected.

Development of a full Structure Plan, with a view to formal adoption within the District Plan, is advised to give any developers a steer as to what HDC are wanting to see in this area.

Given the lack of knowledge as to what industries are likely to set up here, it is strongly advised individual Integrated Transport Assessments (ITA's) are sought from prospective businesses with more detailed information about movements of vehicles, especially heavy traffic, and their effects on the intersections.



Figure 2.2: Option i: Single Road access off Ford Rd.

⁴ Plan Change 2, Preliminary Draft document, 4 October 2019, provided by Hauraki District Council

⁵ Planning Policy Manual, NZTA, August 2007, Appendix 5B.5



Figure 2.3: W2 indicative road reserves and proposed connection options *Option ii: Roundabout access off SH2.*

2.3.1 Proposed Road Network

The road layout presented in *Option i* shows an internal network with a single access road off Ford Road.

Option ii proposes the creation of a new intersection for this area in the form of a roundabout with SH2 and Waihi Beach Road. This may solve future problems with capacity and safety, and the possibility of resultant undesirable re-routing of vehicles through residential areas. However, given the recent upgrades, and the cost of a roundabout⁶, this will require further investigation with NZTA before any options are included in the Plan. The staged development of W2 will initially have access via Ford Road with an ultimate “direct” access to SH2 implemented at a later stage via the proposed roundabout.

Although the closure of Crean Road is not considered necessary for this adjusted arrangement to work, it has been raised by Waka Kotahi | NZTA as a desire and potential pre-requisite for this development (refer section 2.5.1).

⁶ Indicatively (based on previous similar contracts) in the order of \$6M+ for design and construction for high-speed State Highway areas, not including land acquisition or other unknowns such as geotechnical requirements or service relocation, etc.

2.3.2 Proposed Alternative Mode Links

It is not considered likely these facilities would be required or desirable initially outside of the growth area, however as time progresses and people are encouraged onto alternative modes, or as the Waihi urban area expands further south, cycle facilities and footpaths may become necessary.

If there is sufficient demand, the number 85 “Town Connector” bus service could be routed to service this area.

2.4 Modelling Assessments

2.4.1 Trip Distribution

Trip distribution has been assessed at a conceptual level using the principles of gravity modelling, a high-level method of determining likely travel patterns based on existing known origins and destinations.

Using the attractors as a guide for weighting of trip distribution choice, at any one intersection the traffic flow in any direction currently on that road is proportionally split based on the most popular routes and likely destinations.

This method offers a desk top approach to assessing traffic patterns and turning flows in the absence of actual turning counts and origin destination surveys. The results are used to inform the indicative intersection models and give an indication as to whether intersections are currently functioning as intended, and whether they will continue to do so if more vehicles are added.

2.4.1.1 Modelling Basis

Given the relative simplicity of the internal road network and proposed connections, no specific gravity model has been produced for W2; the interaction with future growth areas may change this, and a holistic model of some kind will need to be considered in this eventuality.

Note: This section revised in August 2024.

On revisiting traffic figures, it was discovered that traffic volumes on State Highway 2 have decreased from our assumed Base year (refer assumptions below), as has the HCV proportion (figures from December 2023). This could be for a variety of reasons, and worth noting the Covid-19 pandemic occurred between the two sampled dates.

Due to this we have changed the nomenclature of the modelling intervals from “real” numbered years to hypothetical “BaseX” years. Based on an assumed 2% growth (in face of negative growth up to this point), it will take until 2030 to fully recover traffic volumes to our assumed Base year level (7,635); for this reason it will be important to keep a reasonable track of traffic growth on both roads as the development progresses (refer section 2.6 Recommendations).

For the purposes of this assessment, the Base year is considered to be the year at which development begins; all subsequent iterations are labelled by number of years after this point (so “Base1” is 1 year following start of development).

The following assumptions were used in calculating flows for intersection modelling:

- The ADT data was pro-rated to a Base year using 2019 figures with a 2% per annum traffic growth average⁷;

⁷ NZTA Economic Evaluation Manual (October 2013)

- A Projected year of Base plus 16 years ("Base16") using a 2% per annum traffic growth average was also used; this projection was chosen following experience of other similar development sites within the Hauraki District (client informed).
- The average daily peaks will be 10% of the ADT⁸;
- HCV proportion of traffic remains constant.
- The flows on any one road are split 70/30⁹ for direction based on the time of day and direction of attractors. In this instance the growth area is expected to be a commuting attractor, so the AM peak demand is expected to be largely towards this area, the PM peak largely away from this area.

2.4.1.2 Model Limitations

It is important to note that the traffic data and assumed turning proportions are hypothetical and have not been verified by counts or site observations, the model is therefore derived from predicted routing based on attractor assumptions, anecdotal evidence, and local knowledge of the report authors.

2.4.1.3 Development Figures

The future development of W2 has been assumed to be additional to the standard 2% traffic growth in this area; this is not strictly correct, as the traffic has to come from somewhere and industrial growth of this type would be a large contributor towards it, however retaining this assumption does provide for a conservative model.

Two development scenarios over and above a standard 2% growth were considered:

- 1 Low Development: A scenario whereby the lower value of the expected peak range (0.2 veh/hr per 100 m² site area) is adopted. This is the equivalent of approximately 240 veh/hr generated from the development during the AM and PM peak hours combined in the Base year.
- 2 High Development: A scenario whereby the higher value of the expected range (0.3 veh/hr per 100 m² site area) is adopted. This is the equivalent of approximately 360 veh/hr generated from the development during the AM and PM peak hours combined in the Base year.

2.4.2 Intersection Modelling

The following intersections were modelled in Sidra Intersection 8.0¹⁰ for levels of service, all based on the logic stated in section 2.4.1 above:

- *Option i:* State Highway 2 and Ford Road.
- *Option ii:* State Highway 2 and Waihi Beach Road proposed as a roundabout.

The Level of Service for any lane is directly related to the average delay anticipated for a vehicle in that lane, as follows:

⁸ NZTA Research Report 453 (November 2011)

⁹ NZ Trips and Parking Database (June 2008)

¹⁰ Recognised industry standard intersection modelling software

Table 2.6: Level of Service (LoS): Sidra 8 Sign Control

Level of Service (LoS) for $v/c \leq 1.0$ ($v/c > 1.0$ = LoS F)	Average Delay per Vehicle in seconds (d)
A	$d \leq 10$
B	$10 < d \leq 15$
C	$15 < d \leq 25$
D	$25 < d \leq 35$
E	$35 < d \leq 50$
F	$50 < d$

The following assumptions, in addition to those mentioned in section 2.4.1, were used when setting the parameters of the Sidra model:

- No gradients are known, so all gradients for all approaches were set at 0%.
- All measurements possible were taken from aerial views on Google Earth.
- If a median was present it was assumed to act as a Right Turn Bay in lieu of an actual Right Turn Bay.
- If present, shoulders were considered 'full' (of parked vehicles for example) and so not considered as additional seal width¹¹;
- Growth area W6 and W7 were considered to be fully developed, with traffic numbers included in the background growth.

¹¹ Although there is no formal parking on these rural roads, the wide shoulder on the State Highway does lend itself to this activity. Without this assumption the model may use the additional seal width to allow vehicles to pass each other which, while this may happen in reality, tends to provide an overly optimistic view of traffic use of the intersection.

2.4.2.1 State Highway 2 and Ford Road

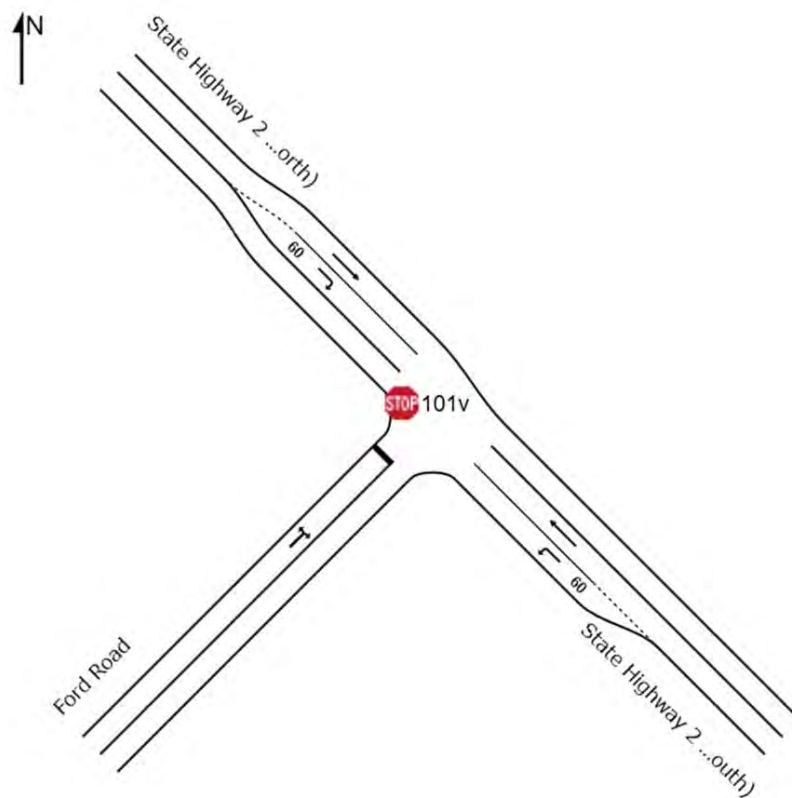


Figure 2.4: Sidra Intersection Diagram – State Highway 2 and Ford Road.

This intersection was modelled for the following situations:

- Base year plus Low Development (LD) AM and PM peaks.
- Base16 at 2% growth plus High Development (HD), AM and PM peaks.

The current proposed Base year situation plus Low Development (LD) and the forecast Base16 scenario plus High Development (HD) situation as indicated in the two bullet points above were modelled to check the impact of the W2 proposal.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix C.

Table 2.7: AM Peak LoS

Scenario	State Highway 2 (North)		State Highway 2 (South)		Ford Road
	Straight	Right	Left	Straight	
Base + LD	A	B	A	A	D
Base16 + HD	A	F	A	A	F

Table 2.8: PM Peak LoS

Scenario	State Highway 2 (North)		State Highway 2 (South)		Ford Road
	Straight	Right	Left	Straight	
Base + LD	A	A	A	A	C
Base16 + HD	A	B	A	A	F

The results indicate that the intersection should operate reasonably well during peak hours at current traffic volumes plus the new development, however by the Base16+HD scenario the Ford Road approach to the intersection is over capacity in both the AM and PM peaks together with SH2 right-turn lane into Ford Road in the AM Peak.

In reality the intersection will probably still operate as the traffic will re-route to other less congested intersections on the network but will warrant further investigation as part of future development TIA's.

2.4.2.2 State Highway 2 and Waihi Beach Road roundabout

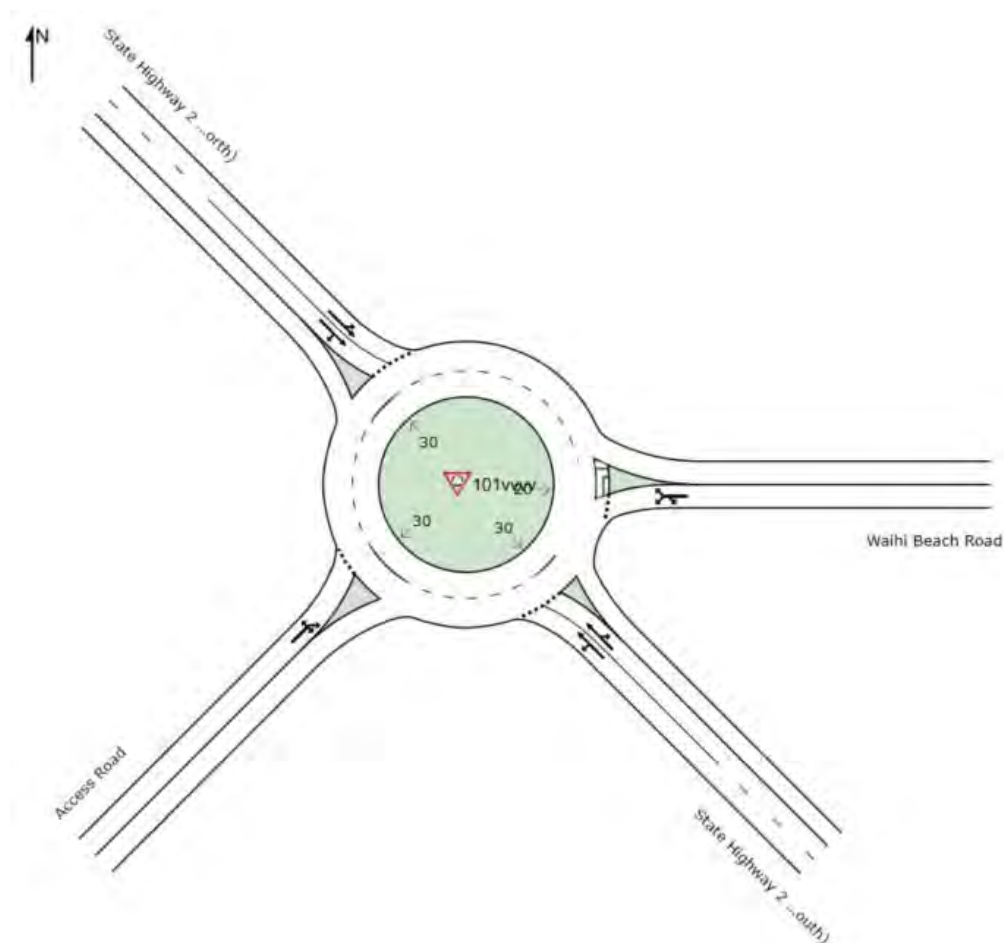


Figure 2.5: Sidra Intersection Diagram – State Highway 2 and Waihi Beach Road.

This intersection was modelled for the following situations:

- Base year plus Low Development (LD) AM and PM peaks.
- Base16 at 2% growth plus High Development (HD), AM and PM peaks.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix C.

Table 2.9: AM Peak LoS

Scenario	State Highway 2 (North)			State Highway 2 (South)			Waihi Road	New Access Road
	Left	Straight	Right	Left	Straight	Right		
Base + LD	A	B	B	A	A	A	A	A
Base16 + HD	A	A	A	A	B	B	A	A

Table 2.10: PM Peak LoS

Scenario	State Highway 2 (North)			State Highway 2 (South)			Waihi Road	New Access Road
	Left	Straight	Right	Left	Straight	Right		
Base + LD	A	A	A	A	A	A	A	A
Base16 + HD	A	B	B	A	A	A	A	B

The results indicate that a roundabout intersection will operate well for both development scenarios and horizons.

2.4.3 Intersection capacity

2.4.3.1 Current scenarios

Further modelling of the State Highway 2 and Ford Road intersection has been undertaken to determine when the intersection will no longer have the capacity to handle the growth in traffic volume along Ford Road.

Several iterations of the models for the Low and High Development scenarios looked at in section 2.4.2, and a third situation with no development and only standard growth in the transport network (2% annual growth year on year), were run to determine the first theoretical year from the Base (expressed as “BaseX”) in which Ford Road at the State Highway 2 intersection reaches a failing (F) LoS grade.

Years either side of the determined failures were double-checked to ensure the failure didn’t occur earlier under that level of development / growth.

The modelling indicates that when Ford Road reaches 41 peak hour vehicle trips in Base24, this is the expected failure year if no development were to happen and only natural traffic volume growth in the network occurs. If only a Low level of development were to occur, failure of the intersection at

Ford Road is modelled to happen in Base9 when traffic volumes reach 272 peak hour vehicle trips along Ford Road.

While these are good indicators, it is important to note that the growth on each road of an intersection are interdependent, and it appears the traffic on the State Highway is having a significant influence on how much traffic can exit Ford Road.

Traffic generated from Low Development is approximately 60% of that expected for High Development. Ford Road at the State Highway 2 Intersection currently does not have the capacity to handle the traffic volumes associated with the High Development scenario.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix C.

Table 2.11: AM Peak LoS

Scenario	State Highway 2 (North)		State Highway 2 (South)		Ford Road
	Straight	Right	Left	Straight	
Base1 + HD	A	B	A	A	F
Base9 + LD	A	B	A	A	F
Base24	A	C	A	A	F

Table 2.12: PM Peak LoS

Scenario	State Highway 2 (North)		State Highway 2 (South)		Ford Road
	Straight	Right	Left	Straight	
Base1 + HD	A	B	A	A	D
Base9 + LD	A	B	A	A	D
Base24	A	B	A	A	E

2.4.3.2 Interim proposal

During the modelling work, an interim proposal of adding a second lane to the Ford Road exit (left and right out lanes) was considered to see if the capacity of the intersection could be retained for a longer period.

It was found that, while average delay was reduced thanks to the left-turning vehicles not being held up as much by the right-turning vehicles, the reduction was not sufficient to prevent the right turn out achieving a LoS of F in the same year it had under the analysis above.

2.4.3.3 Roundabout proposal

The proposed State Highway 2 and Waihi Beach Road roundabout (see Figure 2.5 for layout) was modelled for the years in which each of the scenarios reached a fail LoS for Ford Road.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix C.

Table 2.13: AM Peak LoS

Scenario	State Highway 2 (North)			State Highway 2 (South)			Waihi Road	New Access Road
	Left	Straight	Right	Left	Straight	Right		
Base1 + HD	A	A	A	A	B	B	A	A
Base9 + LD	A	A	A	A	B	B	A	B
Base24	A	A	A	A	B	B	A	B

Table 2.14: PM Peak LoS

Scenario	State Highway 2 (North)			State Highway 2 (South)			Waihi Road	New Access Road
	Left	Straight	Right	Left	Straight	Right		
Base1 + HD	A	B	A	A	A	A	A	B
Base9 + LD	A	B	A	A	A	A	A	B
Base24	A	B	A	A	B	B	A	B

The results indicate that a roundabout intersection will operate well for the same traffic volumes that exceed the capacity of the existing State Highway 2 and Ford Road intersection.

2.4.4 Crash Prediction Modelling

Using the predicted traffic volume increase on the network in a Base16 plus High Development worst-case scenario, as assigned in the modelling above, the Crash Prediction Modelling was updated assuming the road corridors were not otherwise altered by the developments.

Table 2.15: Crash Model Results (Combined)

Road Name	Predicted Injury Crash Rate (existing)	Predicted Injury Crash Rate (Base16 + HD)
Ford Road	0.025	0.212
SH2, Waihi Beach Rd Intersection	0.38	0.439
SH2, Ford Intersection	0.046	0.288

Table 2.15 shows a predicted increase in injury crashes as development progresses, which is not unexpected, given the additional volume of traffic on the network in addition to the new flows from the development.

2.5 Conclusion

This area of the network is experiencing high traffic demand, which is impacting on the levels of service at a relatively minor intersection such as Ford Road/SH2 and may be contributing to some of the injury

crashes reported in CAS. The median right-turn lanes implemented by NZTA in 2019 on SH2 at Ford and Crean Roads is however expected to improve overall junction safety and likely to reduce the Crash rate statistic post 2019.

Development of this area will increase this pressure, even with the alterations already implemented at this intersection, and for the *Option i* (Ford Road access), the levels of service on the Ford Road approach (although acceptable in the Base year with a Low Development scenario) are expected to be poor with a high industrial development scenario.

Through further modelling to determine capacity trigger points, it was determined that intersection capacity would be exceeded as follows:

Table 2.16: Intersection capacity exceeded

Capacity Exceeded Scenario	Ford Road (veh/day)		State Highway Traffic (veh/day)
	<i>Standard traffic growth</i>	<i>Development traffic</i>	
Base24 (2%)	410	0	12,800
Base9 + LD	320	2,400	11,200
Base1 + HD	270	3,600	10,700

Note: State Highway figures rounded to nearest 100

It is important to note, however, that the ability of the intersection to function is interdependent, and worst performing lanes observed in the modelling regardless of exact vehicle numbers are for right turns out of or into Ford Road (refer modelling outputs in Appendix C), all other lanes seem to operate acceptably. This suggests the key governing factor is the ability of motorists to find an acceptable gap in the State Highway traffic.

For *Option ii* (SH2 Roundabout access), the access provides a more direct and safe entry onto SH2 with good levels of service for all development scenarios and horizons tested. It also takes away the inherent issues with gap-acceptance in a high-speed environment.

2.5.1 Waka Kotahi – NZ Transport Agency Commentary

Following review of an earlier draft of this report, Waka Kotahi – NZ Transport Agency (NZTA) have indicated they do not consider this location is conducive to good travel demand management and future multi-modal travel options. *Further clarity over the scope and extent of this issue should be sought to develop future options for this proposed growth area.*

Should this location go ahead as currently envisioned, NZTA have the following requirements:

- More detailed analysis of industrial yield, trip generation and distribution, and intersection level of service based on detailed modelling.
- Confirmation of proposed mitigation measures (*Note: NZTA have indicated they are open to further engagement and seem supportive of the idea of a roundabout at Waihi Beach Road, providing Crean Road and Ford Road are both closed at the same time¹²;*
- A land use pattern assessment should be undertaken.
- Staging provisions made clear (*Note: this would normally be developed as part of the Structure Planning*).

¹² Note that an amendment to this condition to keep Crean Road open could be argued due to the reduced W2 traffic generation footprint that no longer has access off Crean Road.

2.6 Recommendations

It is recommended site verification, namely traffic counting and turning counts, is carried out before the development of the site to better understand existing traffic volumes around this growth area, and exactly when peak flows occur.

Staging of the growth area should be linked to consideration of the expected traffic generation of individual activities and developments, with reference back to the original models to confirm that the overall traffic impacts are not significantly greater than current assumptions.

It may be appropriate during the development of the Structure Plan to consider different scenarios for speed limits, improvements to the major intersections, and heavy vehicle restrictions. Impact assessments from individual developers may aid HDC in assessing these outcomes going forward.

From the transport assessment undertaken, it is recommended considering a dedicated roundabout intersection for this area combined with the Waihi Beach Road intersection on SH2 prior to the Base9 scenario (2,400 veh/day generated by the development) when the State Highway 2 and Ford Road intersection appears to no longer have the capacity to handle the traffic volume growth and Low Development levels of traffic generation coming from Ford Road. Any proposal that increases demand on the State Highway intersection would need to take account of the requirements of the NZTA stated above.

Allowing for the time to consent, design and build a roundabout, a “start planning” trigger should be considered if a roundabout is adopted as the preferred solution long-term. This has been estimated as the traffic volumes generated by the development three years prior to those in the Base9 scenario. Assuming linear progression from Base to Base 9 this would mean the “start planning” trigger would be when the development is contributing 1,600 veh/day.

It will also be important to monitor traffic volumes along Ford Road and the State Highway as development progresses to ensure the underlying traffic growth figures are not out of step with those presented in Table 2.16.

3 Waihi: W4 – Waitete Road

3.1 Growth Area

The W4 growth area (shown in Figure 3.1) comprises some 0.6 ha of land on the northern fringe of Waihi, currently zoned rural and situated adjacent to Thorn Road, north of the intersection with Rata Street. Figure 1 in Appendix A shows the location of the W4 growth area within the greater Waihi District.



Figure 3.1: Approximate extents of W4 growth area (image sourced from Google Earth).

3.2 Existing Situation

3.2.1 Existing Transport Environment

The only road bordering growth area W4 is Thorn Road to the east, designated as a Local Road in the Hauraki District Plan¹³.

Thorn Road becomes Waitete Road south of Rata Street, which leads to an intersection with Orchard Road approximately 1 km south of the growth area, which then connects at a 'T'-intersection to State Highway 2. These roads are all consistent with a peri-urban environment, or urban fringe.

There is an existing pedestrian footpath on the western side of Thorn Road up to the boundary of W4.

¹³ Hauraki District Plan, Hauraki District Council, September 2014, Map L3

Table 3.1: Road Details (Existing)

Road Name	Total Lane Width (m)	Lanes	Shoulder	Cycle Facilities	Footpaths	Posted Speed (km/hr)
Waitete Road	5.5 to 7.5	2 (inferred from width)	None	None	None north of Albert St 1.5 m one side only, south of Albert St	100 (<i>north of Rata St</i>) 50 (<i>south of Rata St</i>)
Orchard Road	6.5	2	None	None	None	50
State Highway 2	6.8	2	2x 2.0 m approx.	None specifically provided	None on SH in vicinity of Orchard Road – boulevard arrangement where local roads run parallel with paths	70

Note: Measurements are approximate only using Google Earth.

3.2.2 Crash History

The NZTA Crash Analysis System (CAS) was interrogated for the period 2009 to 2019 (inclusive) to provide crash data for the roads in the immediate vicinity of the development and the closest key State Highway intersection. Full CAS outputs including crash diagrams can be found in Appendix D.

Table 3.2: Historical Crash Numbers

Road Name	Number of Crashes	Non-injury	Minor Injury (M)	Death or Serious (DSI)	Crash Injury Rate	Years
Waitete Road	1	1	0	0	0.0	2016
Orchard Road	1	0	0	1	0.1	2010
State Highway 2	3	2	1	0	0.1	1x 2015 (1x M) 2x 2010

No crashes are recorded in the immediate vicinity of W4.

The route from the growth area to State Highway 2 has two (2) crashes along its length, unrelated to intersections (one turning out of driveway into parked car, one pedestrian struck walking along roadside), with a further three (3) associated with the Orchard Road intersection with State Highway 2.

Of these, three one injury was recorded in a nose-to-tail incident which was not identified as a direct intersection issue as it was due to distraction on the part of the following driver.

3.2.3 Crash Prediction Modelling

A high-level Crash Prediction Model was put together for the existing situation on both State Highway 2, and Waitete and Orchard Road, using the methods and formulae found in NZTA's Crash Estimation Compendium (2016, Updated June 2019).

State Highway 2 approximately 200 m either side of the Orchard Road intersection was assessed under the mid-block only formula; Waitete and Orchard Roads were also assessed using this method.

This modelling method can be said to account for minor intersections and private accesses, which is the most common type along these stretches of road.

Table 3.3: Crash Model Results (Existing)

Road Name	Predicted Injury Crash Rate (existing)	Actual Injury Crash Rate	Differential: Predicted to Actual	Differential Rate
Waitete Road (mid-block)	0.070	0.0	-0.070	-100%
Orchard Road (mid-block)	0.010	0.1	+0.090	+90%
State Highway 2 (mid-block)	0.094	0.1	+0.006	+6%

The sections of Orchard Road and State Highway 2 are revealed to have higher injury crash rates than would normally be expected, whilst Waitete Road is lower.

It is worth noting that an injury crash rate of 0.010 is equivalent to 1 crash every 100 years, and NZTA only currently have around 40 years of data at their disposal. Extending the search range for the full data available (rather than just the last 10 years, as is normal practice) reveals this is still the only injury crash on Orchard Road in that time period.

3.2.4 Road Safety

The existing road network around W4 is rural in nature. Generally, the local road network has no extensive provision for pedestrians or cyclists beyond wide reasonably flat grassed berms, though as noted in section 3.2.1, a footpath is provided on the western side of Thorn Road up to the boundary of W4.

The main concern along this route for drivers is the 90-degree corner at the southern end of the long, straight Waitete Road as it turns into Orchard with minimal signage, however there is no crash history to back up this concern.

3.2.5 Travel Patterns

No traffic survey has been undertaken, however using industry accepted practice in lieu of count or observation data, and existing data from the Road Assessment and Maintenance Management database (RAMM) we can infer likely peak travel patterns.

This data was extracted from Mobileroad.org, which is populated using Road Controlling Authority (RCA) RAMM¹⁴ data. It was noted that while the State Highway traffic data appeared to be based on recent counts (December 2019), the HDC roads were all identified as estimates from 2019 and 2019, so we are unsure as to the accuracy of the data for that part of the network.

Spreadsheet count data was provided by HDC, however these counts dated from prior to the estimates on the Mobileroad.org website and so were considered likely to be out of date for the purposes of this assessment.

The key RAMM data used in this assessment is shown in Table 3.4.

¹⁴ The "Road Assessment and Maintenance Management" system. This data is maintained by RCAs (usually NZTA and Local authorities) for tracking and forecasting maintenance activities on their respective networks.

Table 3.4: RAMM Data

Road Name	Average Daily Traffic (ADT) (veh/day)	Date of Count / Estimate	Heavy Vehicles (%)
Thorn Road (at W4)	45	13/02/2019	6%
Waitete Road (Rata to Regent Streets)	136	13/02/2019	6%
Waitete Road (Regent Street to Kimberley Road)	332	13/02/2019	5%
Waitete Road (Kimberley Road to Albert Street)	257	13/02/2019	6%
Waitete Road (Albert to Orchard Streets)	232	13/02/2019	6%
Orchard Road	326	13/02/2019	3%
State Highway 2	9,008	25/12/2019	10%

Note: All data obtained from MobileRoad.org, all 2-way traffic.

The attractors for determining travel patterns are considered to be as follows:

Table 3.5: Attractors and Type

Location	Approximate Distance from W4	Attractor Type	Attractions
Waihi Town Centre	2.0 km	Local Primary Attractor	• Closest shopping centre • Key employment area
Paeroa	20 km	Primary Attractor	• Employment • Shopping facilities • Recreation
Tauranga	58 km	Primary Attractor	• Nearest city • Large employment base • Closest large-format shopping opportunity
Waihi Beach	12 km	Secondary Attractor	• Key holiday destination • Employment area • Recreational facilities
Coromandel peninsula destinations	25 km plus	Secondary Attractor	• Key holiday destination • Recreational facilities
Local Rural Areas	1 km plus	Secondary Attractor	• Employment • Outdoor Recreation
Auckland and the wider Waikato	25 km plus	Tertiary Attractor	• Alternative opportunities for shopping • Wider entertainment options

From these assumptions, we can reasonably assume that the majority of traffic will travel south towards the State Highway intersection, distributing from there both east towards Waihi town centre, Waihi Beach and beyond to Coromandel Peninsula and Tauranga, and to the west towards Paeroa, Waikato and Auckland, returning from those same directions in similar proportions.

3.2.6 Public Transport

There are no bus routes, or other method of public transport, servicing this part of Waihi according to the “Baybus.co.nz” website. The nearest bus service is available from Waihi town centre some 2 km away, servicing Waihi Beach and on to Katikati, linking up with a connector route to Tauranga city.

3.2.7 Other Modes

Walking could be popular for local access and for those who do not have access to private transport.

Cycling is likely to be more recreational and otherwise limited to dedicated local commuters and local school children.

Realistically, however, the majority of trips in this area are still likely to be private vehicle based regardless of the distance to travel.

3.3 Proposed Situation

The proposed development area is intended to be used for a mixture of housing densities, as per the Hauraki District Plan¹⁵.

The provided Plan Change 2¹⁶ document estimates 7 lots, which would give an average land area per lot of around 850 m², not allowing for public spaces and roads if required.

3.3.1 Proposed Road Network

The proposed area could reasonably service 7 lots with driveways from the existing Thorn Road, some of which may be shared amongst more than one property, or a simple cul-de-sac arrangement if a dedicated road is desired.

Once onto Waitete Road there are several methods by which vehicles could be distributed throughout the local road network, and given the small number of lots proposed and likely small trip generation as a result, the impact on any one intersection is considered to be less than minor.

3.3.2 Proposed Alternative Mode Links

As development starts to expand in this area HDC may consider providing wider footpaths to provide a shared facility for cyclists, and link these with existing paths closer to the State Highway.

3.4 Modelling Assessments

3.4.1 Trip Distribution

Trip distribution has been assessed at a conceptual level based on existing known data.

Using the attractors as a guide, at any one intersection the traffic flow in any direction currently on that road is proportionally split based on the most popular routes and likely destinations.

Peak traffic flows are estimated at 7 veh/hr in a low density, and 14 veh/hr in a higher density scenario.

Given the low starting traffic figures even in a higher density scenario, and the number of options for traffic movements between the proposed growth area and the nearest major road, the impact on any one intersection is expected to be less than minor, so no specific intersection modelling has been undertaken for growth area W4.

¹⁵ Hauraki District Plan, Hauraki District Council, September 2014, section 5.7

¹⁶ Plan Change 2, Preliminary Draft document, 4 October 2019, provided by Hauraki District Council

3.4.2 Crash Prediction Modelling

Using the predicted traffic volume increase on the network in a 2048 plus higher density worst-case scenario, as noted in the modelling discussion above, the Crash Prediction Modelling was updated assuming the road corridors were not otherwise altered by the developments.

Table 3.6: Crash Model Results (Combined)

Road Name	Predicted Injury Crash Rate (existing)	Predicted Injury Crash Rate (2048 without W4)	Predicted Injury Crash Rate (2048 + W4 HD)
Waitete Road	0.070	0.088	0.117
Orchard Road	0.010	0.025	0.030
State Highway 2	0.094	0.156	0.157

This shows a predicted increase in injury crashes as development progresses, which is not unexpected given the additional volume of traffic expected on the respective roads as a result.

The last column (“2048 + W4 Higher Density”) assumes that all additional vehicles end up on these three roads, which as discussed in the previous section is not realistic, however it does demonstrate a worst-case scenario for future crash statistics.

This shows that the worst-case increase in expected crashes due to the development is minimal.

3.5 Conclusion

The existing injury crash rate on Orchard Road is higher than is predicted by models from the NZTA guidelines. However, whilst the proportional increase seems significant, the starting level is lower than is measurable with the current data available, and a wider search indicates that only one injury crash is recorded for this road in the CAS database of approximately 40 years’ worth of data.

Due to the low expected trip generation numbers, even in a higher density development scenario, and the number of options for traffic disbursement into the local road network before accessing a major road, modelling was considered un-necessary as the effects are likely to be unmeasurable in any one location.

3.5.1 Waka Kotahi – NZ Transport Agency Commentary

Following review of an earlier draft of this report, NZTA had no concerns or further comment to make regarding this proposed development area.

3.6 Recommendations

Whilst some safety concerns have been raised with regards the existing local roads in the vicinity of the new growth area W4, there is no recorded accident history to suggest there is currently an issue. The expected traffic growth from this area is not anticipated to noticeably change this.

4 Waihi: W6 & W7 – Bradford Street

4.1 Growth Area

The W6 growth area comprises some 8.4 ha of land to the south of Waihi between Bradford Street and the upper portion of the Ohinemuri River, currently zoned Low Density.

The W7 growth area (comprising approx. 7.2 ha) is located on either side and on the west end of Bradford Street. W7 is to remain zoned as low density residential with W6 to be rezoned as residential (from low density residential). Extents of the W6 and W7 growth areas are shown in Figure 4.1. Figure 1 in Appendix A shows the location of the W6 and W7 growth areas within the greater Waihi District.



Figure 4.1: Approximate extents of W6 and W7 growth areas (image sourced from Google Earth).

4.2 Existing Situation

4.2.1 Existing Transport Environment

The only road bordering growth areas W6 and W7 is Bradford Street to the north-west, designated as a Local Road in the Hauraki District Plan¹⁷.

Bradford Street leads directly to Victoria Street, running north-south and designated an Arterial Road, which leads onto an east-west Arterial to the north, Kenny Street, before reaching State Highway 2.

¹⁷ Hauraki District Plan, Hauraki District Council, September 2014, Map L3

Any traffic wanting to head south can access State Highway 2 by following Victoria Street south, then using Crean Road to bypass the urban area, and is likely the fastest route in this circumstance.

Bradford Street has a footpath on the opposite side to the W6 growth area, which continues on the south side to the east of Robin Street through to Victoria Street. No dedicated cycle facilities are present.

These roads are all consistent with a peri-urban environment, or urban fringe.

Table 4.1: Road Details (Existing)

Road Name	Total Lane Width (m)	Lanes	Shoulder	Cycle Facilities	Footpaths	Posted Speed (km/hr)
Bradford Street	5.5 to 7.0	2 (unmarked, inferred from width)	None	None	1x 2.0 m approx. on northern side between Robin Street and western end of Bradford Street	50
Victoria Street	8.5 to 10.0	2	Unmarked, but wide enough	None	1x 1.2 m approx., western side Kenny Street to No. 48 Victoria Street	50
Kenny Street	8.0	2	2x 2.0 m, plus wider bays near intersection	None specifically provided	1x 1.2 m approx. heading west, both sides heading east (southern 4 m wide approx.)	50
State Highway 2 (north at Kenny Street)	6.8	2 + median and Right Turn Bays	2x 1.0 m approx.	None specifically provided	None on SH in vicinity of Kenny Street– boulevard arrangement where local roads run parallel with paths	70
State Highway 2 (south at Crean Road)	7.2	2	2x 2.5 m approx.	None specifically provided	None	100
Crean Road	6.0 to 7.0	2	None	None	None	100

Note: Measurements are approximate only using Google Earth.

4.2.2 Crash History

The NZTA Crash Analysis System (CAS) was interrogated for the period 2009 to 2019 (inclusive) to provide crash data for the roads in the immediate vicinity of the development and the closest key State Highway intersection. Full CAS outputs including crash diagrams can be found in Appendix E.

Table 4.2: Historical Crash Numbers

Road Name	Number of Crashes	Non-injury	Minor Injury (M)	Death or Serious (DSI)	Crash Injury Rate	Years
Bradford Street	0	0	0	0	0.0	n/a
Victoria Street	10	6	3	1	0.4	1x 2017 (M) 1x 2016 1x 2014 1x 2013 1x 2012 3x 2011 (1x DSI, 2x M)
Kenny Street	2	2	0	0	0.0	2x 2012
State Highway 2 (north at Kenny Street)	1	0	1	0	0.1	1x 2012
State Highway 2 (south at Crean Road)	5	2	1	2	0.3	1x 2019 (M) 1x 2015 3x 2011 (2x DSI)
Crean Road	1	1	0	0	0.0	1x 2019

No crashes are recorded in the immediate vicinity of W6 and W7.

Victoria Street appears to have the largest number of accidents currently, related to intersections or manoeuvres other than the Bradford Street exit.

The intersection between Victoria Street and Consols Street seems to be a key accident site with 5 separate crashes, 4 of these being failures to give way at a priority traffic control. This trend would likely continue as traffic flows increase.

There are a total of six crashes around the Crean Road intersection with State Highway 2, one at the Crean Road intersection itself; it is noted that work has been done by NZTA relatively recently with regards the intersections along this stretch of State Highway 2 and all listed accidents occurred prior to that work finishing.

4.2.3 Crash Prediction Modelling

A high-level Crash Prediction Model was put together for the existing situation on both State Highway 2, and key roads surrounding W6 and W7 such as Victoria Street, Kenny Street and Crean Road, using the methods and formulae found in NZTA's Crash Estimation Compendium (2016, Updated June 2019).

State Highway 2 was assessed under the intersection product of flow (exposure) method for both its intersection with Kenny Street and its intersection with Crean Road, as they may both be affected by the development. All other roads were assessed under the mid-block only formula.

Table 4.3: Crash Model Results (Existing)

Road Name	Predicted Injury Crash Rate (existing)	Actual Injury Crash Rate	Differential: Predicted to Actual	Differential Rate
Bradford Street (mid-block)	0.030	0.0	-0.030	-100%
Victoria Street (mid-block)	0.066	0.4	+0.334	+600%
Kenny Street (mid-block)	0.032	0.0	-0.032	-10%
State Highway 2 (north at Kenny Street)	0.433	0.1	-0.333	-30%
State Highway 2 (south at Crean Road)	0.038	0.3	+0.262	+800%
Crean Road (mid-block)	0.051	0.0	-0.051	-100%

The sections of Bradford Street and Crean Road have had no accidents during the assessment period, and so have a much lower rate than predicted.

Victoria Street has a higher accident rate than predicted, as the predicted rate is quite low (equivalent to approximately 1 every 15 years) but there have been 4 injury crashes during the assessment period. This could be indicative of a problem with this route and may need further investigation. Similarly, the State Highway 2 (south at Crean Road) intersection appears to be performing much worse than predicted.

4.2.4 Road Safety

The existing road network around W6 and W7 is peri-urban, or urban fringe, in nature. Pedestrians are reasonably well catered for with footpaths along Victoria Street and Bradford Street, though typically only on one side.

Generally, the local road network has no provision for cyclist specific facilities beyond wide reasonably flat grassed berms.

4.2.5 Travel Patterns

No traffic survey has been undertaken, however using industry accepted practice in lieu of count or observation data, and existing data from the Road Assessment and Maintenance Management database (RAMM) we can infer likely peak travel patterns.

This data was extracted from Mobileroad.org, which is populated using Road Controlling Authority (RCA) RAMM¹⁸ data. It was noted that while the State Highway traffic data appeared to be based on recent counts (December 2019), the HDC roads were all identified as estimates from 2019 and 2019, so we are unsure as to the accuracy of the data for that part of the network.

¹⁸ The "Road Assessment and Maintenance Management" system. This data is maintained by RCAs (usually NZTA and Local authorities) for tracking and forecasting maintenance activities on their respective networks

Spreadsheet count data was provided by HDC, however these counts dated from prior to the estimates on the Mobileroad.org website and so were considered likely to be out of date for the purposes of this assessment.

The key RAMM data used in this assessment is as follows:

Table 4.4: RAMM Data

Road Name	Average Daily Traffic (ADT) (veh/day)	Date of Count / Estimate	Heavy Vehicles (%)
Bradford Street	230	13/02/2019	1%
Victoria Street	1,142	13/02/2019	9%
Kenny Street	3,656	13/02/2019	11%
State Highway 2 (north at Kenny Street)	9,008	25/12/2018	10%
State Highway 2 (south at Crean Road)	11,718	13/02/2019	12%
Crean Road	293	13/02/2019	9%

Note: All data obtained from MobileRoad.org, all 2-way traffic.

The attractors for determining travel patterns are considered to be as follows:

Table 4.5: Attractors and Type

Location	Approximate Distance from W6	Attractor Type	Attractions
Waihi Town Centre	1.4 km	Local Primary Attractor	• Closest shopping centre • Key employment area
Paeroa	19 km	Primary Attractor	• Employment • Shopping facilities • Recreation
Tauranga	56 km	Primary Attractor	• Nearest city • Large employment base • Closest large-format shopping opportunity
Waihi Beach	10 km	Secondary Attractor	• Key holiday destination • Employment area • Recreational facilities
Coromandel peninsula destinations	25 km plus	Secondary Attractor	• Key holiday destination • Recreational facilities
Local Rural Areas	1 km plus	Secondary Attractor	• Employment • Outdoor Recreation
Auckland and the wider Waikato	25 km plus	Tertiary Attractor	• Alternative opportunities for shopping • Wider entertainment options

From these assumptions, we can reasonably assume that the majority of traffic will travel north towards the northern State Highway intersection, distributing from there both east towards Waihi

town centre and beyond to Coromandel Peninsula, and to the west towards Paeroa, Waikato and Auckland, returning from those same directions in similar proportions.

A proportion will travel south towards the southern State Highway 2 intersection at Crean Road if they wish to head towards Tauranga or Waihi Beach, also returning in similar proportions.

4.2.6 Public Transport

There are no bus routes, or other method of public transport, servicing this part of Waihi according to the “Baybus.co.nz” website. The nearest bus service is available from Waihi town centre some 1.4 km away, servicing Waihi Beach and on to Katikati, linking up with a connector route to Tauranga city.

4.2.7 Other Modes

Walking could be popular for local access and for those who do not have access to private transport.

Cycling is likely to be more recreational and otherwise limited to dedicated local commuters and local school children.

Realistically, however, the majority of trips in this area are still likely to be private vehicle based regardless of the distance to travel.

4.3 Proposed Situation

The proposed development area is intended to be used for a mixture of housing densities, as per the Hauraki District Plan¹⁹.

The provided Plan Change 2²⁰ document estimates 90 lots for W6, which calculates to an average lot density of 1,020 m² per lot, not allowing for public spaces and roads if required. At this density, W7 provides an additional 73 lots.

Development of a full Structure Plan, with a view to formal adoption within the District Plan, is advised to give any developers a steer as to what lot sizes and level of servicing would be expected, and whether HDC have an appetite for higher densities in certain areas, or small commercial facilities (‘local shops’), for example.

¹⁹ Hauraki District Plan, Hauraki District Council, September 2014, section 5.7

²⁰ Plan Change 2, Preliminary Draft document, 4 October 2019, provided by Hauraki District Council



Figure 4.2: W6 and W7 indicative extents

4.3.1 Proposed Road Network

The intersection for the W6 growth area has been chosen to be located on Bradford Street because it is already of sufficient width to handle further traffic; the location has been chosen at the apex of a rise in the road so sight distances in both directions are not hampered. Access (including internal access) to the W7 growth areas is via the existing Colesburg Lane (northern W7 parcel), Grenadier Lane (southern W7 parcel) and directly to the now extended Bradford Street.

No connection has been suggested through to Connell Street as this would form a direct connection down an existing cul-de-sac and would fundamentally change the nature of this road, and the desire not to spread traffic over multiple intersections onto Victoria Street or provide a shortcut, or “rat-run,” if it can be avoided.

It would, however, provide the opportunity for a pedestrian and cycle connection through if so desired in the future.

4.3.2 Proposed Alternative Mode Links

As development starts to expand in this area, HDC may consider providing for improved connections between the existing footpaths in the vicinity of W6 and those leading to attraction centres (e.g., along Victoria Street) such as Waihi town centre, possibly made wider to provide a shared facility for cyclists.

It is not considered likely these facilities would be required heading south towards Crean Road at this time.

4.4 Modelling Assessments

4.4.1 Trip Distribution

Trip distribution has been assessed at a conceptual level using the principles of gravity modelling, a high-level method of determining likely travel patterns based on existing known origins and destinations.

Using the attractors as a guide, at any one intersection the traffic flow in any direction currently on that road is proportionally split based on the most popular routes and likely destinations.

This method offers a desktop approach to assessing traffic patterns and turning flows in the absence of actual turning counts and origin destination surveys. The results are used to inform the indicative intersection models and give an indication as to whether intersections are currently functioning as intended, and whether they will continue to do so if more vehicles are added.

4.4.1.1 Modelling Basis

Given the relative simplicity of the internal road network and proposed connections, no specific gravity model has been produced for W6 and W7; the interaction with future growth areas may change this, and a holistic model of some kind will need to be considered in this eventuality.

The following assumptions were used in calculating flows for intersection modelling:

- The ADT data was pro-rated to a Base Year of 2019 using a 2% per annum average²¹;
- A Projected Year of 2048 using a 2% per annum average was also used; 2048 was chosen as this is the latest year this growth area is expected to be fully developed by.
- The average daily peaks will be 10% of the ADT²²;
- The flows on any one road are split 70/30²³ for direction based on the time of day and direction of attractors (i.e., 70% AM towards highest attractors, 70% PM away from highest attractors).
- The flows on Kenny Street at its intersection with Victoria and Galbraith Streets, and State Highway 2 at its intersection with Kenny Street, were treated as a 50/50 split due to their position in the network, being quite central it is likely drivers could choose either direction to reach the same attractor.

4.4.1.2 Model Limitations

It is important to note that the traffic data and assumed turning proportions are hypothetical and have not been verified by counts or site observations, the model is therefore derived from predicted routing based on attractor assumptions, anecdotal evidence, and local knowledge of the report authors.

4.4.1.3 Development Figures

The future development of W6 and W7 has been assumed to be additional to the standard 2% traffic growth in this area; this is not strictly correct, as the traffic has to come from somewhere and this type of residential growth tends to be what supports it, however retaining this assumption does provide for a conservative model.

Two development scenarios over and above a standard 2% growth were considered:

- 1 **Low Development:** A scenario whereby the lot yield as presented in the Plan Change 2 document (at a density of 1,000m²/lot) was used to determine additional traffic flow.

²¹ NZTA Economic Evaluation Manual (October 2013)

²² NZTA Research Report 453 (November 2011)

²³ NZ Trips and Parking Database (June 2008)

- 2 **High Development:** A scenario whereby the lot yield was doubled when compared to that in the Plan Change 2 document, to account for a worst-case scenario of smaller lot types and future in-fill development.

The daily traffic per lot was assumed to be 10veh/day, with all other traffic assumptions as per those in section 4.4.1 above.

4.4.2 Intersection Modelling

The following intersections were modelled with Sidra Intersection 8.0 software for levels of service (LoS), all based on the logic stated in section 4.4.1 above:

- Kenny, Victoria and Galbraith Streets.
- State Highway 2 and Kenny Street.

The Level of Service for any lane is directly related to the average delay anticipated for a vehicle in that lane, as follows:

Table 4.6: Level of Service (LoS): Sidra 8 Sign Control

Level of Service (LoS) for $v/c \leq 1.0$ ($v/c > 1.0$ = LoS F)	Average Delay per Vehicle in seconds (d)
A	$d \leq 10$
B	$10 < d \leq 15$
C	$15 < d \leq 25$
D	$25 < d \leq 35$
E	$35 < d \leq 50$
F	$50 < d$

The following assumptions, in addition to those mentioned in section 4.4.1, were used when setting the parameters of the Sidra model:

- No gradients are known, so all gradients for all approaches were set at 0%.
- All measurements possible were taken from aerial views on Google Earth.
- If a median was present it was assumed to act as a Right Turn Bay in lieu of an actual Right Turn Bay.
- If present, shoulders were considered 'full' (of parked vehicles for example) and so not considered as additional seal width.
- Growth area W2 was considered to be fully developed, with traffic numbers included in the background growth.

4.4.2.1 Kenny, Victoria and Galbraith Streets

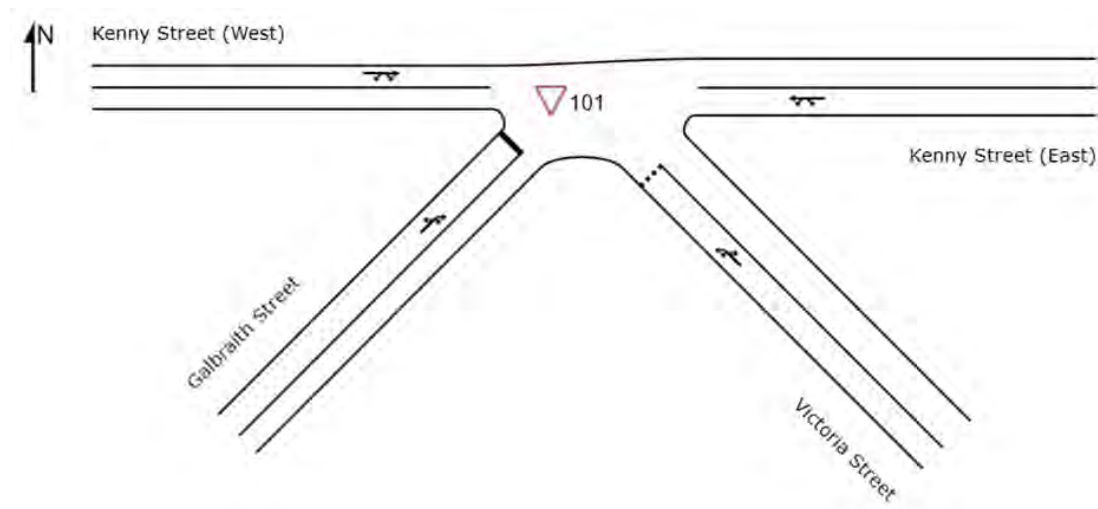


Figure 4.3: Sidra Intersection Diagram – Kenny, Victoria and Galbraith Streets.

This intersection was modelled for the following situations:

- 2019 plus Low Development (LD) AM and PM peaks.
- 2048 2% growth plus High Development (HD), AM and PM peaks.

Initially only the current 2019 proposed Low Development situation, and the forecast 2048 High Development situation indicated above were modelled to check the development impact; given the results, no further modelling was deemed to be necessary.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix F.

Table 4.7: AM Peak LoS

Scenario	Kenny Street West	Kenny Street East	Victoria Street	Galbraith Street
2019 + LD	A	A	A	B
2048 + HD	A	A	B	C

Table 4.8: PM Peak LoS

Scenario	Kenny Street West	Kenny Street East	Victoria Street	Galbraith Street
2019 + LD	A	A	A	B
2048 + HD	A	A	B	C

The results indicate that the intersection should operate reasonably well during peak hours at all levels of development to 2048.

4.4.2.2 State Highway 2 and Kenny Street

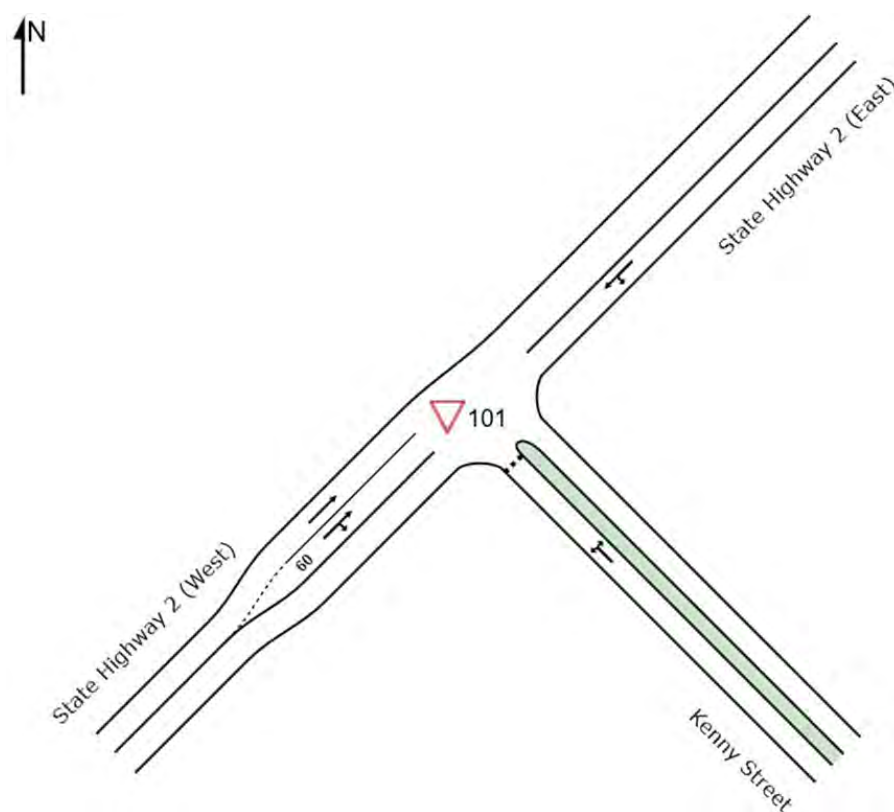


Figure 4.4: Sidra Intersection Diagram – State Highway 2 and Kenny Street.

This intersection was modelled for the following situations:

- 2019 plus Low Development (LD) AM and PM peaks.
- 2048 2% growth plus High Development (HD), AM and PM peaks.
- 2048 2% growth, no development included, AM and PM peaks.

Initially only the current proposed situation, and the forecast extreme situation indicated in the first two bullet points above were modelled to check the extreme ends of the development impact; given the results, the final model was created as a final check on the impact of the W6 and W7 proposal.

The following tables summarise the LoS findings for each leg / lane by scenario for quick reference. Summaries of the modelling reports can be found in Appendix F.

Table 4.9: AM Peak LoS

Scenario	SH2 West		SH2 East	Kenny Street
	Straight	Right Turn Bay		
2019 + LD	A	A	A	F
2048	A	F	A	F
2048 + HD	A	F	A	F

Table 4.10: PM Peak LoS

Scenario	SH2 West		SH2 East	Kenny Street
	Straight	Right Turn Bay		
2019 + LD	A	A	A	E
2048	A	F	A	F
2048 + HD	A	F	A	F

The results indicate that the Kenny Street leg of the intersection experiences significant delay during peak hours (particularly the AM Peak) at current traffic volumes plus the new development, with the SH2 right-turn lane into Kenny Street showing poor LoS metrics by 2048 with or without the new development.

In reality, the intersection may probably operate marginally better than indicated above as the traffic will initially re-route to other less congested intersections on the network but may be short lived and thus warrants further investigation.

4.4.3 Crash Prediction Modelling

Using the additional vehicles assumed to be using the network in a 2048 plus High Development worst-case scenario, as assigned in the modelling above, the Crash Prediction Modelling was updated assuming the road corridors were not otherwise altered by the developments.

Table 4.11: Crash Model Results

Road Name	Predicted Injury Crash Rate (existing)	Predicted Injury Crash Rate (2048 + HD)
Bradford Street	0.030	0.436
Victoria Street	0.066	0.175
Kenny Street	0.032	0.068
State Highway 2 (north at Kenny Street)	0.433	0.797

This shows an increase in expected injury crashes at all locations as development increases, which is not unexpected given the additional volume of traffic on the network in addition to the new flows from the development. With all generated traffic using Bradford Street, expected 2048 Injury Crash rates increase considerably.

4.5 Conclusion

The predicted injury rates along affected roads are not expected to increase significantly apart from along Bradford Street. The intersection between Kenny Street and State Highway 2, as well as the potential impacts of both W2 and W6 and W7 growth areas are expected to put pressure on these two intersections. The net effect is likely to increase demands at other intersections at various points along the main roads as traffic re-routes away from the more severely affected areas.

In the short term, the Kenny Street approach at the State Highway 2/Kenny Street intersection experiences significant delay with W6 and W7 in place.

4.6 Recommendations

It is recommended traffic and safety are monitored during development of the Structure Plan with particular emphasis on traffic volumes around the State Highway 2/Kenny Street intersection to determine the peak hour conditions.

Further modelling, and/or refining of the existing models, should be undertaken to confirm the poor levels of service identified in this report should the W6 and W7 growth areas fully develop, taking into account potential route redistribution motorists would initially consider towards avoiding the intersection; targeted discussions can then be held with NZTA regarding when they had anticipated funding any improvement programmes and whether this needs to be accelerated.

5 Summary

Growth areas W2, W4, W6 and W7, all in the Waihi area of Hauraki District, were assessed for both the existing and potential future statuses of the transport network.

Considerations were as follows:

- Existing nature of the roads and other transport facilities around each growth area, including safety considerations.
- Crash history for the existing roads, including a comparison against NZTA Crash Prediction Modelling.
- Likely attractors for travel and resulting travel patterns.
- Network assessment using the principles of 'Gravity Modelling' for those travel patterns in various scenarios from Existing to a predicted 2035 2% per annum increase plus High Development of the growth areas (anticipating future sub-division).
- Intersection modelling for key locations based on the assessed trip distribution.
- A comparison of the worst case future Crash Prediction Model with the existing situation.

Taking all these factors, including results of modelling exercises, into account the following conclusions and recommendations were reached.

For reference, a set of Figures showing indicative growth area boundaries and road layouts can be found in Appendix A.

Growth Area W2: Crean Road and Ford Road Conclusions and Recommendations:

Note: This section revised in August 2024.

On revisiting traffic figures, it was discovered that traffic volumes on State Highway 2 have decreased from our assumed Base year (refer assumptions below), as has the HCV proportion (figures from December 2023). This could be for a variety of reasons, and worth noting the Covid-19 pandemic occurred between the two sampled dates.

Due to this we have changed the nomenclature of the modelling intervals from "real" numbered years to hypothetical "BaseX" years. Based on an assumed 2% growth (in face of negative growth up to this point), it will take until 2030 to fully recover traffic volumes to our assumed Base year level (7,635); for this reason it will be important to keep a reasonable track of traffic growth on both roads as the development progresses (refer section 2.6 Recommendations).

For the purposes of this assessment, the Base year is considered to be the year at which development begins; all subsequent iterations are labelled by number of years after this point (so "Base1" is 1 year following start of development).

This area of the network is experiencing high traffic demand, which is impacting on the levels of service at a relatively minor intersection such as Ford Road/SH2 and may be contributing to some of the injury crashes reported in CAS. The median right-turn lanes implemented by NZTA in 2019 on SH2 at Ford and Crean Roads is however expected to improve overall junction safety and likely to reduce the Crash rate statistic post 2019.

Development of this area will increase this pressure, even with the alterations already implemented at this intersection, and for the *Option i* (Ford Road access), the levels of service on the Ford Road approach (although acceptable in the Base year with a Low Development scenario) are expected to be poor with a high industrial development scenario.

Through further modelling to determine capacity trigger points, it was determined that intersection capacity would be exceeded as follows:

Table 5.1: Intersection capacity exceeded

Capacity Exceeded Scenario	Ford Road (veh/day)		State Highway Traffic (veh/day)
	Standard traffic growth	Development traffic	
Base24 (2%)	410	0	12,800
Base9 + LD	320	2,400	11,200
Base1 + HD	270	3,600	10,700

Note: State Highway figures rounded to nearest 100

It is important to note, however, that the ability of the intersection to function is interdependent, and worst performing lanes observed in the modelling regardless of exact vehicle numbers are for right turns out of or into Ford Road (refer modelling outputs in Appendix C), all other lanes seem to operate acceptably. This suggests the key governing factor is the ability of motorists to find an acceptable gap in the State Highway traffic.

For *Option ii* (SH2 Roundabout access), the access provides a more direct and safe entry onto SH2 with good levels of service for all development scenarios and horizons tested. It also takes away the inherent issues with gap-acceptance in a high-speed environment.

It is recommended site verification, namely traffic counting and turning counts, is carried out before the development of the site to better understand existing traffic volumes around this growth area, and exactly when peak flows occur.

Staging of the growth area should be linked to consideration of the expected traffic generation of individual activities and developments, with reference back to the original models to confirm that the overall traffic impacts are not significantly greater than current assumptions.

It may be appropriate during the development of the Structure Plan to consider different scenarios for speed limits, improvements to the major intersections, and heavy vehicle restrictions. Impact assessments from individual developers may aid HDC in assessing these outcomes going forward.

From the transport assessment undertaken, it is recommended considering a dedicated roundabout intersection for this area combined with the Waihi Beach Road intersection on SH2 prior to the Base9 scenario (2,400 veh/day generated by the development) when the State Highway 2 and Ford Road intersection appears to no longer have the capacity to handle the traffic volume growth and Low Development levels of traffic generation coming from Ford Road. Any proposal that increases demand on the State Highway intersection would need to take account of the requirements of the NZTA as follows below.

Allowing for the time to consent, design and build a roundabout, a “start planning” trigger should be considered if a roundabout is adopted as the preferred solution long-term. This has been estimated as the traffic volumes generated by the development three years prior to those in the Base9 scenario. Assuming linear progression from Base to Base 9 this would mean the “start planning” trigger would be when the development is contributing 1,600 veh/day.

It will also be important to monitor traffic volumes along Ford Road and the State Highway as development progresses to ensure the underlying traffic growth figures are not out of step with those presented in Table 2.16.

Following review of an earlier draft of this report, Waka Kotahi – NZ Transport Agency (NZTA) have indicated they do not consider this location is conducive to good travel demand management and

future multi-modal travel options. Further clarity over the scope and extent of this issue should be sought to develop future options for this proposed growth area.

Should this location go ahead as currently envisioned, however, NZTA have the following requirements:

- More detailed analysis of industrial yield, trip generation and distribution, and intersection level of service based on detailed modelling.
- Confirmation of proposed mitigation measures (*Note: NZTA have indicated they are open to further engagement and seem supportive of the idea of a roundabout at Waihi Beach Road, providing Crean Road and Ford Road are both closed.*
- A land use pattern assessment should be undertaken.
- Staging provisions made clear (*Note: this would normally be developed as part of the Structure Planning*).

Growth Area W4: Waitete Road Conclusions and Recommendations:

The existing injury crash rate on Orchard Road is higher than is predicted by models from the NZTA guidelines. However, whilst the proportional increase seems significant, the starting level is lower than is measurable with the current data available, and a wider search indicates that only one injury crash is recorded for this road in the CAS database of approximately 40 years' worth of data.

Due to the low expected trip generation numbers, even in a higher density development scenario, and the number of options for traffic disbursement into the local road network before accessing a major road, modelling was considered un-necessary as the effects are likely to be unmeasurable in any one location.

Whilst some safety concerns have been raised with regards the existing local roads in the vicinity of the new growth area W4, there is no recorded accident history to suggest there is currently an issue. The expected traffic growth from this area is not anticipated to noticeably change this.

We consider that the impact of W4 on the existing network will be negligible in terms of safety, efficiency and levels of service. NZTA had no further comments on W4.

Growth Area W6 and W7: Bradford Street Conclusions and Recommendations:

Whilst the predicted injury rates along affected roads are not expected to increase significantly, the intersection between Kenny Street and State Highway 2, as well as the potential impacts of both W2 and the W6/W7 growth areas, are expected to put pressure on these two intersections. The net effect is likely to increase demands at other intersections at various points along the main roads as traffic re-routes away from the more severely affected areas.

In the short term, the results indicate that the Kenny Street leg of the intersection experiences significant delay during peak hours at current traffic volumes plus the new development, with the SH2 right-turn lane into Kenny Street showing poor LoS metrics by 2035 with or without the new development.

Further modelling, and/or refining of the existing models, should be undertaken to confirm the poor levels of service identified in this report should the W6 and W7 growth areas fully develop, taking into account potential route redistribution motorists would initially consider towards avoiding the intersection. Discussions can then be held with NZTA regarding when they had anticipated funding any improvement programmes and whether this needs to be accelerated.

It should be noted that whilst we have attempted a localised assessment of interactions between growth areas where obvious, the compounding effect of all these growth areas being developed concurrently have not been fully assessed.

Development of a full Structure Plan for all areas except W4 is advised, with a view to formal adoption within the District Plan. These documents give any developers a steer as to what HDC are wanting to see in this area. A structure plan would bring together all engineering requirements discussed in background documents, such as this one, as well as planning and urban design elements, for example:

- Different zoning within the area (higher and lower densities, localised commercial activities, etc.).
- Indicative road layouts.
- Anticipated three-waters management requirements.
- Other provisions required (such as walking and cycling facilities).

These structure plans become a guidance document for each development area covering all aspects of a development, and are mainly required to convey, and be able to enforce, actions on developers who may otherwise comply with the engineering requirements of the council, but results may be seen as a non-desirable outcome.

6 Applicability

This report has been prepared for the exclusive use of our client Hauraki District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

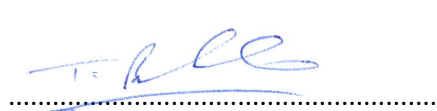
We understand and agree that this report will be used by Hauraki District Council in undertaking its regulatory functions in connection with Hauraki District Plan Change 2.

This report may not be relied upon in other contexts or for any other purpose, or by any person other than Hauraki District Council, without T+T's prior written agreement.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

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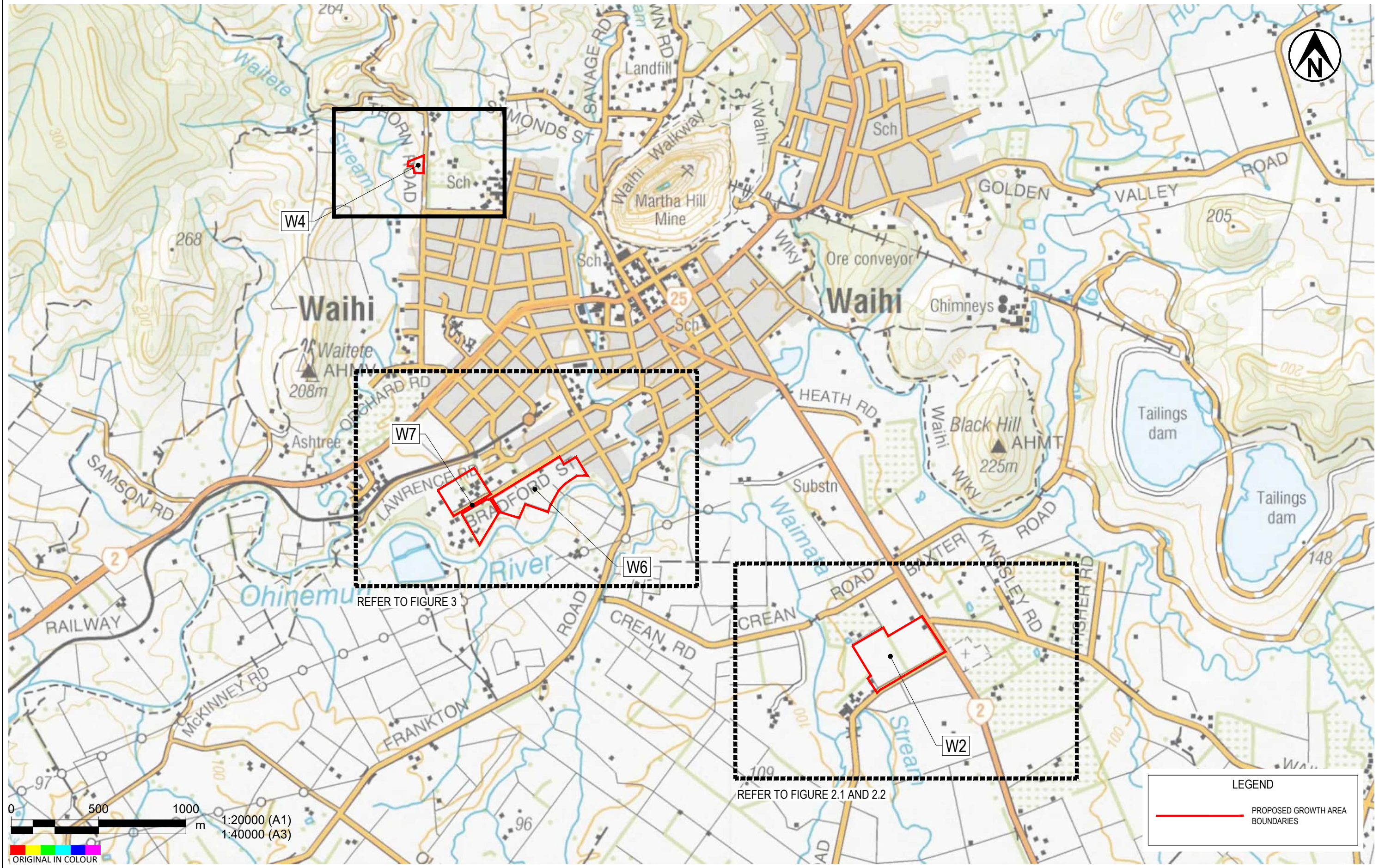
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Appendix A Proposed Growth Area Figures

The following figures are included in this appendix:

- **Figure 1: Overall Layout Plan**
- **Figure 2: Growth Area W2**
- **Figure 3: Growth Area W6 & W7**





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NOTES:

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PROJECT No. 1012502.0000		
DESIGNED	TIBR	Nov.19
DRAWN	MLM	Nov.19
CHECKED		
 06.06.2024		
APPROVED	DATE	

CLIENT **HAURAKI DISTRICT COUNCIL**

PROJECT **HAURAKI TRAFFIC ASSESSMENTS**

TITLE **WAIHI GROWTH AREAS LAYOUT PLAN**

SCALE (A3) 1:20000 FIG No. FIGURE 1 REV 1



NOTES:

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PROJECT No. 1012502.400C

DESIGNED	TIBR	07.23
DRAWN	MLM	07.23
CHECKED		

[Signature] 06.06.2024

APPROVED DATE

CLIENT **HAURAKI DISTRICT COUNCIL**

PROJECT **HAURAKI TRAFFIC ASSESSMENTS**

TITLE **WAIHI GROWTH AREAS
W2 SITE PLAN - OPTION 1**

SCALE (A3) 1:4000

FIG No. FIGURE 2.1

REV 1



NOTES:

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PROJECT No. 1012502.400C

DESIGNED	TIBR	07.23
DRAWN	MLM	07.23
CHECKED		

[Signature] 06.06.2024

APPROVED DATE

CLIENT **HAURAKI DISTRICT COUNCIL**

PROJECT **HAURAKI TRAFFIC ASSESSMENTS**

TITLE **WAIHI GROWTH AREAS
W2 SITE PLAN - OPTION 2**

SCALE (A3) 1:4000

FIG No. FIGURE 2.2

REV 1



Appendix B W2 CAS Outputs



Untitled query

Saved sites

[Waihi W2](#)

Crash year

[2009 — 2019](#)

Plain English report

21 results from your query.

Showing [20](#) [100](#) results at once.

1-21 of 21

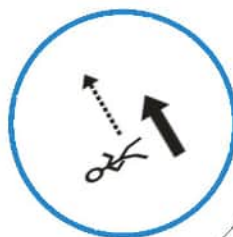
Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
002-0093	74m	S	WAIHI BEACH ROAD	201898129	04/09/2018	Tue	18:45	Ute1 DIRN on 002-0093 changing lanes/overtaking to right hit Car/Wagon2	CAR/WAGON2, other overtaking	Wet	Dark	Light rain	Nil (Default)	Unknown	0	0	0
SH 2	200m	S	BAXTER ROAD	201538218	07/04/2015	Tue	14:50	Car/Wagon1 SDB on SH 2 hit rear end of Car/Wagon2 stopped/moving slowly	CAR/WAGON2, other vehicle controls CAR/WAGON1, failed to notice car slowing, stopping/stationary	Dry	Overcast	Fine	Nil (Default)	Unknown	0	0	0
SH 2	260m	N	BAXTER ROAD	201812082	07/03/2018	Wed	12:55	Truck1 SDB on SH2 hit rear end of Truck2 stop/slow for queue	TRUCK2, alcohol test below limit TRUCK1, alcohol test below limit, failed to notice car slowing, stopping/stationary SUV4, alcohol test below limit CAR/WAGON3, alcohol test below limit	Wet	Overcast	Light rain	Nil (Default)	Unknown	0	0	2
SH 2		I	BAXTER ROAD	201100095	12/09/2011	Mon	19:30	Car/Wagon1 SDB on SH 2 hit Pedestrian2 (Age 53) crossing road from left side	CAR/WAGON1, did not check/notice another party from other dirn, PEDESTRIAN2, alcohol impaired non-driver (pedestrian/cyclist/pa, failed to see another party wearing dark clothing, pedestrian walking across heedless of traffic	Dry	Dark	Fine	T Junction	Nil	1	0	0
SH 2		I	CREAN ROAD	201819223	24/10/2018	Wed	08:30	Van1 NDB on SH2 hit SUV2 turning right onto AXROAD from the left	VAN1, alcohol test below limit SUV2, alcohol test below limit, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Bright sun	Fine	T Junction	Give way	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
SH 2		I	CREAN ROAD	201134608	30/01/2011	Sun	10:58	SUV1 SDB on SH 2 hit rear of Car/Wagon2 SDB on SH 2 turning right from centre line	SUV1, lost control under acceleration	Dry	Overcast	Fine	T Junction	Give way	0	0	0
SH 2	400m	S	FORD ROAD	201655347	16/12/2016	Fri	22:00	Van1 SDB on State highway 2 lost control turning right, Van1 hit non specific fence	VAN1, lost control when turning	Dry	Dark	Fine	Nil (Default)	Unknown	0	0	0
SH 2	100m	S	FORD ROAD	201302046	14/04/2013	Sun	14:53	Car/Wagon1 NDB on SH 2 lost control on straight and hit Car/Wagon2 head on	CAR/WAGON1, other lost control	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	2
SH 2	20m	S	FORD ROAD	201657288	07/12/2016	Wed	14:50	Car/Wagon1 NDB on SH 2 hit obstruction, Car/Wagon1 hit non specific animal	ENV: farm animal straying	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	0
SH 2	5m	S	WAIHI BEACH ROAD	201543838	07/08/2015	Fri	16:55	Van1 SDB on SH 2 hit rear of Car/Wagon2 SDB on SH 2 turning right from centre line	VAN1, failed to notice car slowing, stopping/stationary, other attention diverted, ENV: entering or leaving private house / farm	Dry	Overcast	Fine	Driveway	Give way	0	0	0
SH 2		I	WAIHI BEACH ROAD	2904031	30/07/2009	Thu	10:00	Car/Wagon1 NDB on SH 2 hit Truck2 merging from the right	TRUCK2, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Overcast	Fine	T Junction	Give way	0	0	1
SH 2	120m	N	WAIHI BEACH ROAD	201103205	19/06/2011	Sun	19:58	SUV1 SDB on SH 2 hit Motorcycle2 turning right onto AXROAD from the left	MOTORCYCLE2, alcohol suspected, failed to give way entering roadway from driveway, ENV: entering or leaving private house / farm, fog or mist	Wet	Dark	Mist or Fog	Driveway	Unknown	0	1	0
SH 2		I	WAIHI BEACH ROAD	201618492	04/12/2016	Sun	18:30	Car/Wagon1 SDB on Tauranga Road hit SUV2 turning right onto AXROAD from the left	SUV2, did not check/notice another party from other dirn, failed to give way at priority traffic control, overseas/migrant driver fail to adjust to nz roads	Dry	Bright sun	Fine	T Junction	Give way	0	0	1
SH 2		I	WAIHI BEACH ROAD	201755893	04/12/2017	Mon	18:30	Car/Wagon2 turning right hit by oncoming Car/Wagon1 SDB on SH2	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way turning to non-turning traffic	Dry	Bright sun	Fine	T Junction	Give way	0	0	0
SH 2		I	WAIHI BEACH ROAD	201846868	21/08/2018	Tue	17:30	Car/Wagon1 SDB on Tauranga Road hit Car/Wagon2 U-turning from same direction of travel	CAR/WAGON2, alcohol test below limit, didnt give way entering road not d/way,intersect, other inexperience CAR/WAGON1, alcohol test below limit	Dry	Twilight	Fine	T Junction	Give way	0	0	0
SH 2		I	WAIHI BEACH ROAD	2930404	03/01/2009	Sat	09:00	Car/Wagon1 SDB on SH 2 hit Car/Wagon2 turning right onto AXROAD from the left	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Bright sun	Fine	T Junction	Give way	0	0	0

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	<u>Description of events</u>	<u>Crash factors</u>	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
SH 2	150m	S	WAIHI BEACH ROAD	201100009	21/01/2011	Fri	23:45	Car/Wagon1 NDB on SH 2 lost control on straight and hit Car/Wagon2 head on	CAR/WAGON1, alcohol test above limit or test refused, new driver/under instruction, other lost control, speed on straight CAR/WAGON2, alcohol not suspected, tested and -ve (mot use onl, ENV: slippery road due to rain	Wet	Dark	Light rain	Nil (Default)	Nil	3	1	0
WAIHI BEACH ROAD		I	SH 2	201849280	01/10/2018	Mon	21:27	Car/Wagon1 EDB on SH 2, WAIHI, HAURAKI lost control turning left, Car/Wagon1 hit non specific ditch	CAR/WAGON1, speed entering corner/curve	Dry	Dark	Fine	T Junction	Give way	0	0	0
WAIHI BEACH ROAD		I	SH 2	201042943	07/10/2010	Thu	15:45	Car/Wagon1 NDB on WAIHI BEACH ROAD lost control turning right, Car/Wagon1 hit non specific ditch	CAR/WAGON1, alcohol test above limit or test refused, lost control when turning	Dry	Overcast	Fine	T Junction	Give way	0	0	0
WAIHI BEACH ROAD		I	SH 2	201232656	03/06/2012	Sun	22:55	Car/Wagon1 SDB on WAIHI BEACH ROAD lost control turning left, Car/Wagon1 hit non specific ditch	CAR/WAGON1, lost control - road conditions, ENV: fog or mist, other slippery road	Wet	Dark	Mist or Fog	T Junction	Give way	0	0	0
WAIHI BEACH ROAD		I	SH 2	201104487	04/10/2011	Tue	16:30	Car/Wagon1 WDB on WAIHI BEACH ROAD hit rear end of Car/Wagon2 stop/slow for cross traffic	CAR/WAGON1, failed to notice car slowing, stopping/stationary	Dry	Bright sun	Fine	T Junction	Give way	0	0	1

1-21 of 21

201715801



Untitled query

Saved sites

[Ford Road](#)

Crash year

[2009](#) — [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
FORD ROAD	260m	W	SH 2	201715801	24/07/2017	Mon	18:15	Van1 WDB on Ford Road, Waihi hit Pedestrian2 (Age 24) walking with traffic	PEDESTRIAN2, miscellaneous pedestrian, ENV: other street lighting	Dry	Dark	Fine	Nil (Default)	Unknown	0	1	0

1-1 of 1

Appendix C W2 Modelling Reports

Modelling outputs for the following intersections included:

- **State Highway 2 and Ford Road**
- **State Highway 2 and Waihi Beach Road roundabout**

INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_AM_2019+LD (Site Folder: General)]**

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	90.4 km/h	90.4 km/h
Travel Distance (Total)	1011.9 veh-km/h	1214.2 pers-km/h
Travel Time (Total)	11.2 veh-h/h	13.4 pers-h/h
Desired Speed (Program)	100.0 km/h	
Speed Efficiency	0.90	
Travel Time Index	8.93	
Congestion Coefficient	1.11	
Demand Flows (Total)	1001 veh/h	1201 pers/h
Percent Heavy Vehicles (Demand)	13.1 %	
Degree of Saturation	0.321	
Practical Spare Capacity	189.3 %	
Effective Intersection Capacity	3119 veh/h	
Control Delay (Total)	0.77 veh-h/h	0.93 pers-h/h
Control Delay (Average)	2.8 sec	2.8 sec
Control Delay (Worst Lane)	20.2 sec	
Control Delay (Worst Movement)	30.0 sec	30.0 sec
Geometric Delay (Average)	1.6 sec	
Stop-Line Delay (Average)	1.2 sec	
Idling Time (Average)	0.9 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	1.1 veh	
95% Back of Queue - Distance (Worst Lane)	7.7 m	
Ave. Queue Storage Ratio (Worst Lane)	0.01	
Total Effective Stops	159 veh/h	191 pers/h
Effective Stop Rate	0.16	0.16
Proportion Queued	0.09	0.09
Performance Index	13.6	13.6
Cost (Total)	630.09 \$/h	630.09 \$/h
Fuel Consumption (Total)	120.7 L/h	
Carbon Dioxide (Total)	291.9 kg/h	
Hydrocarbons (Total)	0.031 kg/h	
Carbon Monoxide (Total)	0.620 kg/h	
NOx (Total)	0.886 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 3.3 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.4% 1.7% 0.8%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	480,505 veh/y	576,606 pers/y
Delay	371 veh-h/y	445 pers-h/y
Effective Stops	76,306 veh/y	91,567 pers/y
Travel Distance	485,697 veh-km/y	582,836 pers-km/y
Travel Time	5,375 veh-h/y	6,450 pers-h/y
Cost	302,443 \$/y	302,443 \$/y
Fuel Consumption	57,929 L/y	
Carbon Dioxide	140,089 kg/y	
Hydrocarbons	15 kg/y	
Carbon Monoxide	298 kg/y	
NOx	425 kg/y	

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Organisation: TONKIN & TAYLOR | Licence: NETWORK / 1PC | Processed: Thursday, 27 July 2023 1:35:23 pm

Project: \\ttgroup.local\corporate\Hamilton\Projects\1012502\1012502.4000\WorkingMaterial\MODELLING\W2_SH2_Ford.sip9

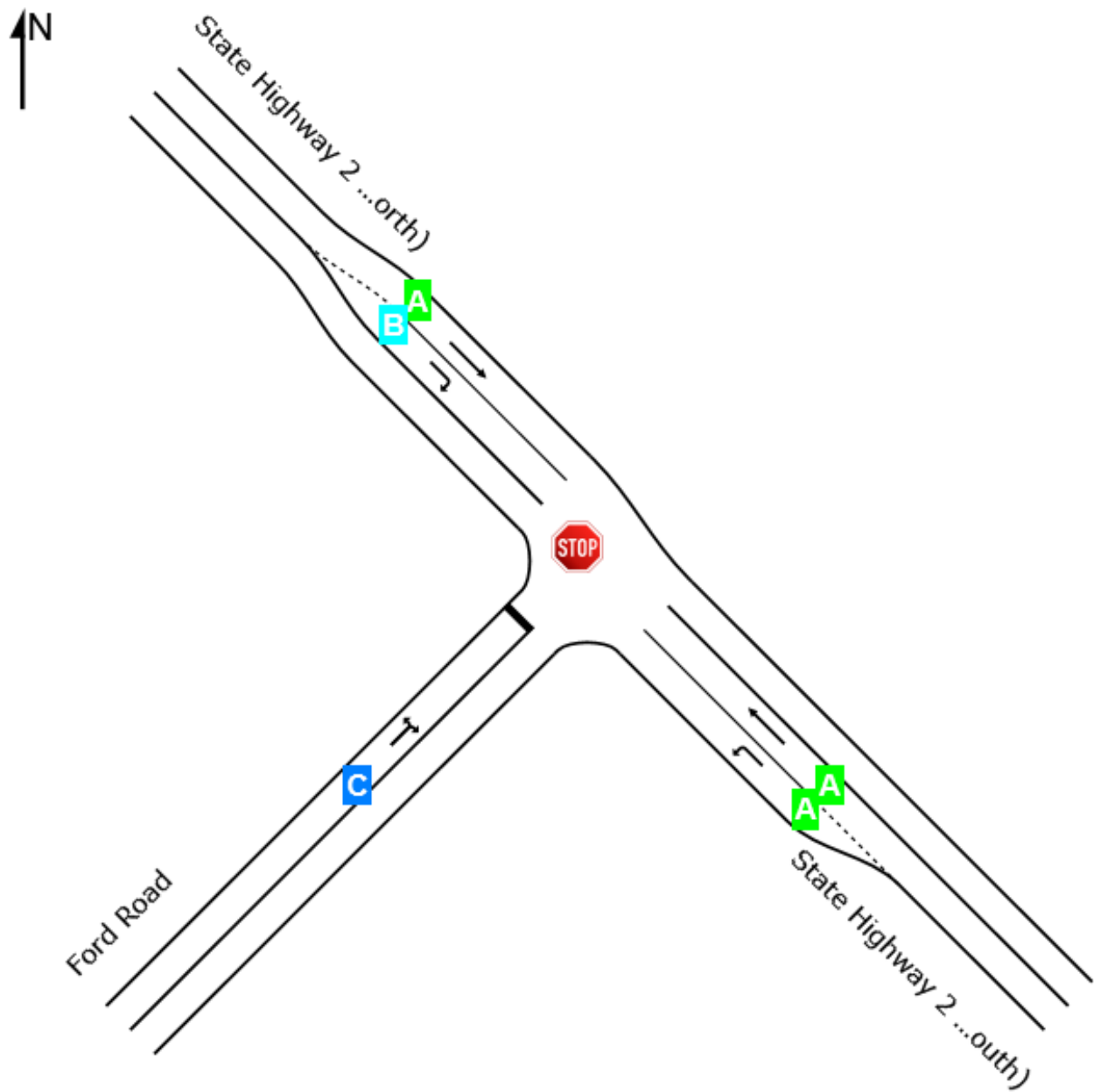
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101v [SH2_Ford_AM_2019+LD (Site Folder: General)]**

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA	NA	C	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_AM_2048+HD (Site Folder: General)]**

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	16.8 km/h	16.8 km/h
Travel Distance (Total)	1906.5 veh-km/h	2287.8 pers-km/h
Travel Time (Total)	113.8 veh-h/h	136.5 pers-h/h
Desired Speed (Program)	100.0 km/h	
Speed Efficiency	0.17	
Travel Time Index	0.75	
Congestion Coefficient	5.97	
Demand Flows (Total)	1886 veh/h	2264 pers/h
Percent Heavy Vehicles (Demand)	13.3 %	
Degree of Saturation	3.223	
Practical Spare Capacity	-75.2 %	
Effective Intersection Capacity	585 veh/h	
Control Delay (Total)	91.69 veh-h/h	110.03 pers-h/h
Control Delay (Average)	175.0 sec	175.0 sec
Control Delay (Worst Lane)	2067.5 sec	
Control Delay (Worst Movement)	2106.5 sec	2106.5 sec
Geometric Delay (Average)	1.9 sec	
Stop-Line Delay (Average)	173.0 sec	
Idling Time (Average)	170.7 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	72.8 veh	
95% Back of Queue - Distance (Worst Lane)	531.5 m	
Ave. Queue Storage Ratio (Worst Lane)	0.43	
Total Effective Stops	719 veh/h	863 pers/h
Effective Stop Rate	0.38	0.38
Proportion Queued	0.39	0.39
Performance Index	246.4	246.4
Cost (Total)	3843.30 \$/h	3843.30 \$/h
Fuel Consumption (Total)	414.0 L/h	
Carbon Dioxide (Total)	993.3 kg/h	
Hydrocarbons (Total)	0.116 kg/h	
Carbon Monoxide (Total)	1.556 kg/h	
NOx (Total)	2.844 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 97.4% 88.1% 0.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	905,432 veh/y	1,086,518 pers/y
Delay	44,011 veh-h/y	52,813 pers-h/y
Effective Stops	345,274 veh/y	414,329 pers/y
Travel Distance	915,104 veh-km/y	1,098,125 pers-km/y
Travel Time	54,605 veh-h/y	65,526 pers-h/y
Cost	1,844,785 \$/y	1,844,785 \$/y
Fuel Consumption	198,730 L/y	
Carbon Dioxide	476,782 kg/y	
Hydrocarbons	56 kg/y	
Carbon Monoxide	747 kg/y	
NOx	1,365 kg/y	

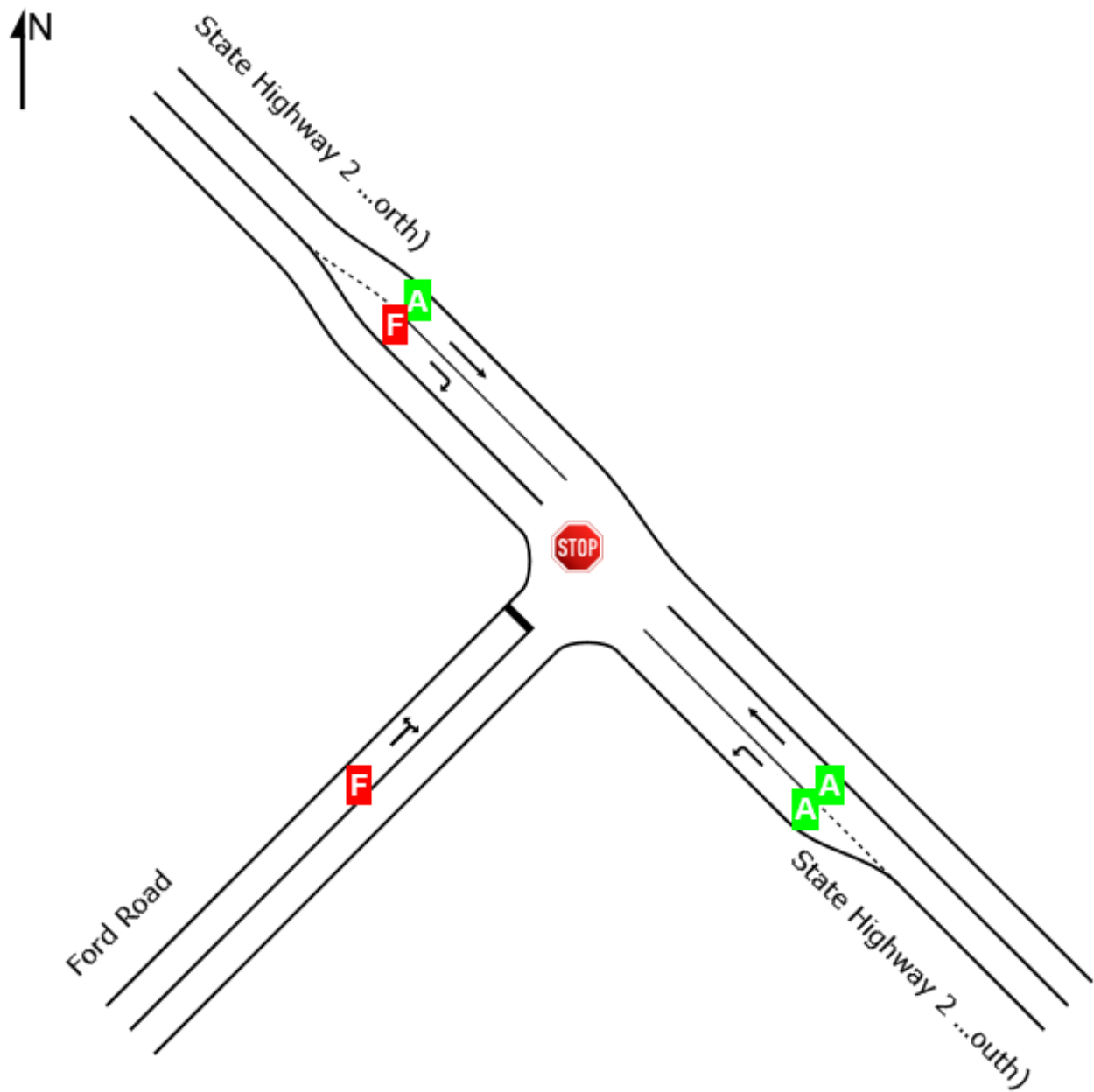
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101v [SH2_Ford_AM_2048+HD (Site Folder: General)]**

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA	NA	F	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_PM_2019+LD (Site Folder: General)]**

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	86.0 km/h	86.0 km/h
Travel Distance (Total)	1126.0 veh-km/h	1351.2 pers-km/h
Travel Time (Total)	13.1 veh-h/h	15.7 pers-h/h
Desired Speed (Program)	100.0 km/h	
Speed Efficiency	0.86	
Travel Time Index	8.45	
Congestion Coefficient	1.16	
Demand Flows (Total)	1114 veh/h	1336 pers/h
Percent Heavy Vehicles (Demand)	12.5 %	
Degree of Saturation	0.451	
Practical Spare Capacity	77.3 %	
Effective Intersection Capacity	2468 veh/h	
Control Delay (Total)	1.35 veh-h/h	1.62 pers-h/h
Control Delay (Average)	4.4 sec	4.4 sec
Control Delay (Worst Lane)	20.8 sec	
Control Delay (Worst Movement)	35.8 sec	35.8 sec
Geometric Delay (Average)	2.4 sec	
Stop-Line Delay (Average)	2.0 sec	
Idling Time (Average)	1.3 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	2.4 veh	
95% Back of Queue - Distance (Worst Lane)	17.7 m	
Ave. Queue Storage Ratio (Worst Lane)	0.01	
Total Effective Stops	260 veh/h	312 pers/h
Effective Stop Rate	0.23	0.23
Proportion Queued	0.12	0.12
Performance Index	18.2	18.2
Cost (Total)	734.38 \$/h	734.38 \$/h
Fuel Consumption (Total)	140.4 L/h	
Carbon Dioxide (Total)	338.8 kg/h	
Hydrocarbons (Total)	0.036 kg/h	
Carbon Monoxide (Total)	0.708 kg/h	
NOx (Total)	0.993 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 1.4 %

Number of Iterations: 5 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.4% 1.2% 0.6%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	534,568 veh/y	641,482 pers/y
Delay	647 veh-h/y	777 pers-h/y
Effective Stops	124,839 veh/y	149,807 pers/y
Travel Distance	540,479 veh-km/y	648,575 pers-km/y
Travel Time	6,282 veh-h/y	7,538 pers-h/y
Cost	352,504 \$/y	352,504 \$/y
Fuel Consumption	67,396 L/y	
Carbon Dioxide	162,640 kg/y	
Hydrocarbons	17 kg/y	
Carbon Monoxide	340 kg/y	
NOx	477 kg/y	

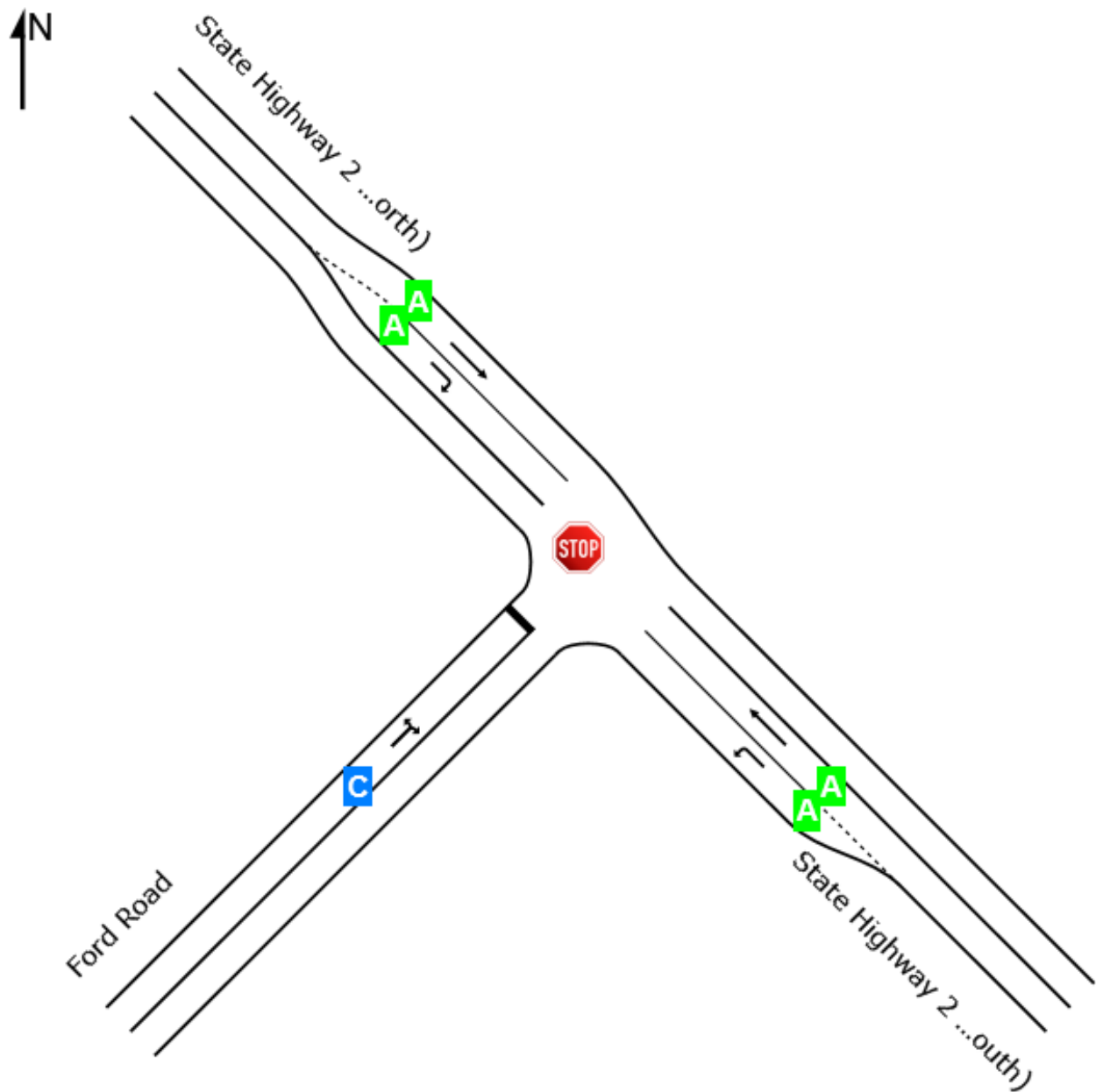
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101v [SH2_Ford_PM_2019+LD (Site Folder: General)]**

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA	NA	C	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_PM_2048+HD (Site Folder: General)]**

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	18.2 km/h	18.2 km/h
Travel Distance (Total)	1707.0 veh-km/h	2048.4 pers-km/h
Travel Time (Total)	94.0 veh-h/h	112.8 pers-h/h
Desired Speed (Program)	100.0 km/h	
Speed Efficiency	0.18	
Travel Time Index	0.91	
Congestion Coefficient	5.51	
Demand Flows (Total)	1688 veh/h	2026 pers/h
Percent Heavy Vehicles (Demand)	12.5 %	
Degree of Saturation	2.008	
Practical Spare Capacity	-60.2 %	
Effective Intersection Capacity	841 veh/h	
Control Delay (Total)	75.06 veh-h/h	90.07 pers-h/h
Control Delay (Average)	160.0 sec	160.0 sec
Control Delay (Worst Lane)	956.0 sec	
Control Delay (Worst Movement)	989.1 sec	989.1 sec
Geometric Delay (Average)	2.3 sec	
Stop-Line Delay (Average)	157.7 sec	
Idling Time (Average)	145.1 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	97.3 veh	
95% Back of Queue - Distance (Worst Lane)	710.5 m	
Ave. Queue Storage Ratio (Worst Lane)	0.57	
Total Effective Stops	1306 veh/h	1568 pers/h
Effective Stop Rate	0.77	0.77
Proportion Queued	0.20	0.20
Performance Index	256.4	256.4
Cost (Total)	3076.46 \$/h	3076.46 \$/h
Fuel Consumption (Total)	310.5 L/h	
Carbon Dioxide (Total)	744.4 kg/h	
Hydrocarbons (Total)	0.091 kg/h	
Carbon Monoxide (Total)	1.257 kg/h	
NOx (Total)	1.741 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.3 %

Number of Iterations: 5 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 4.0% 1.9% 0.9%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	810,442 veh/y	972,531 pers/y
Delay	36,029 veh-h/y	43,234 pers-h/y
Effective Stops	627,068 veh/y	752,481 pers/y
Travel Distance	819,358 veh-km/y	983,230 pers-km/y
Travel Time	45,130 veh-h/y	54,156 pers-h/y
Cost	1,476,701 \$/y	1,476,701 \$/y
Fuel Consumption	149,017 L/y	
Carbon Dioxide	357,295 kg/y	
Hydrocarbons	44 kg/y	
Carbon Monoxide	603 kg/y	
NOx	836 kg/y	

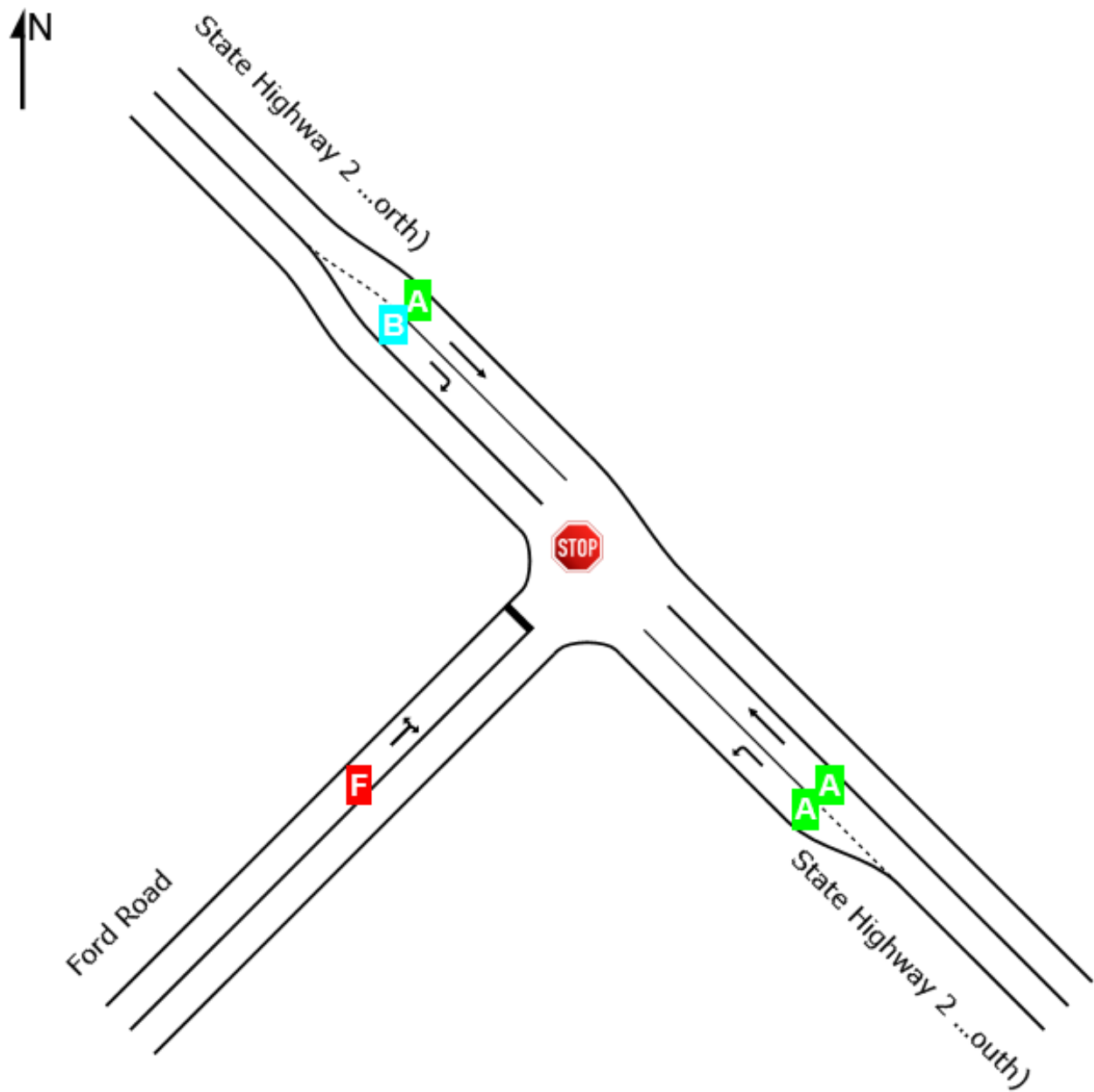
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101v [SH2_Ford_PM_2048+HD (Site Folder: General)]**

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA	NA	F	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_AM_2020 +HD (Site Folder: Version 28/05/2024 (Plus High Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	70.5	70.5 km/h
Travel Distance (Total)	veh-km/h	1257.2	1508.7 pers-km/h
Travel Time (Total)	veh-h/h	17.8	21.4 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.71	
Travel Time Index		6.73	
Congestion Coefficient		1.42	
Demand Flows (Total)	veh/h	1243	1492 pers/h
Arrival Flows (Total)	veh/h	1243	
Percent Heavy Vehicles (Demand)	%	11.9	
Percent Heavy Vehicles (Arrivals)	%	11.9	
Degree of Saturation		0.929	
Practical Spare Capacity	%	-13.9	
Effective Intersection Capacity	veh/h	1339	
Control Delay (Total)	veh-h/h	4.62	5.54 pers-h/h
Control Delay (Average)	sec	13.4	13.4 sec
Control Delay (Worst Lane by MC)	sec	53.2	
Control Delay (Worst Movement by MC)	sec	148.1	148.1 sec
Geometric Delay (Average)	sec	3.0	
Stop-Line Delay (Average)	sec	10.4	
Idling Time (Average)	sec	6.3	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	10.5	
95% Back of Queue - Dist (Worst Lane)	m	76.3	
Ave. Que Storage Ratio (Worst Lane)		0.06	
Effective Stops (Total)	veh/h	539	646 pers/h
Effective Stop Rate		0.43	0.43
Proportion Queued		0.26	0.26
Performance Index		37.5	37.5
Cost (Total)	\$/h	920.09	920.09 \$/h
Fuel Consumption (Total)	L/h	165.8	
Carbon Dioxide (Total)	kg/h	399.3	
Hydrocarbons (Total)	kg/h	0.044	
Carbon Monoxide (Total)	kg/h	0.81	
NOx (Total)	kg/h	1.122	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 82.9% 66.8% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	596,716	716,059 pers/y
Delay (Total)	veh-h/y	2,217	2,660 pers-h/y

Effective Stops (Total)	veh/y	258,513	310,215 pers/y
Travel Distance (Total)	veh-km/y	603,479	724,174 pers-km/y
Travel Time (Total)	veh-h/y	8,555	10,266 pers-h/y
Cost (Total)	\$/y	441,642	441,642 \$/y
Fuel Consumption (Total)	L/y	79,586	
Carbon Dioxide (Total)	kg/y	191,654	
Hydrocarbons (Total)	kg/y	21	
Carbon Monoxide (Total)	kg/y	390	
NOx (Total)	kg/y	539	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

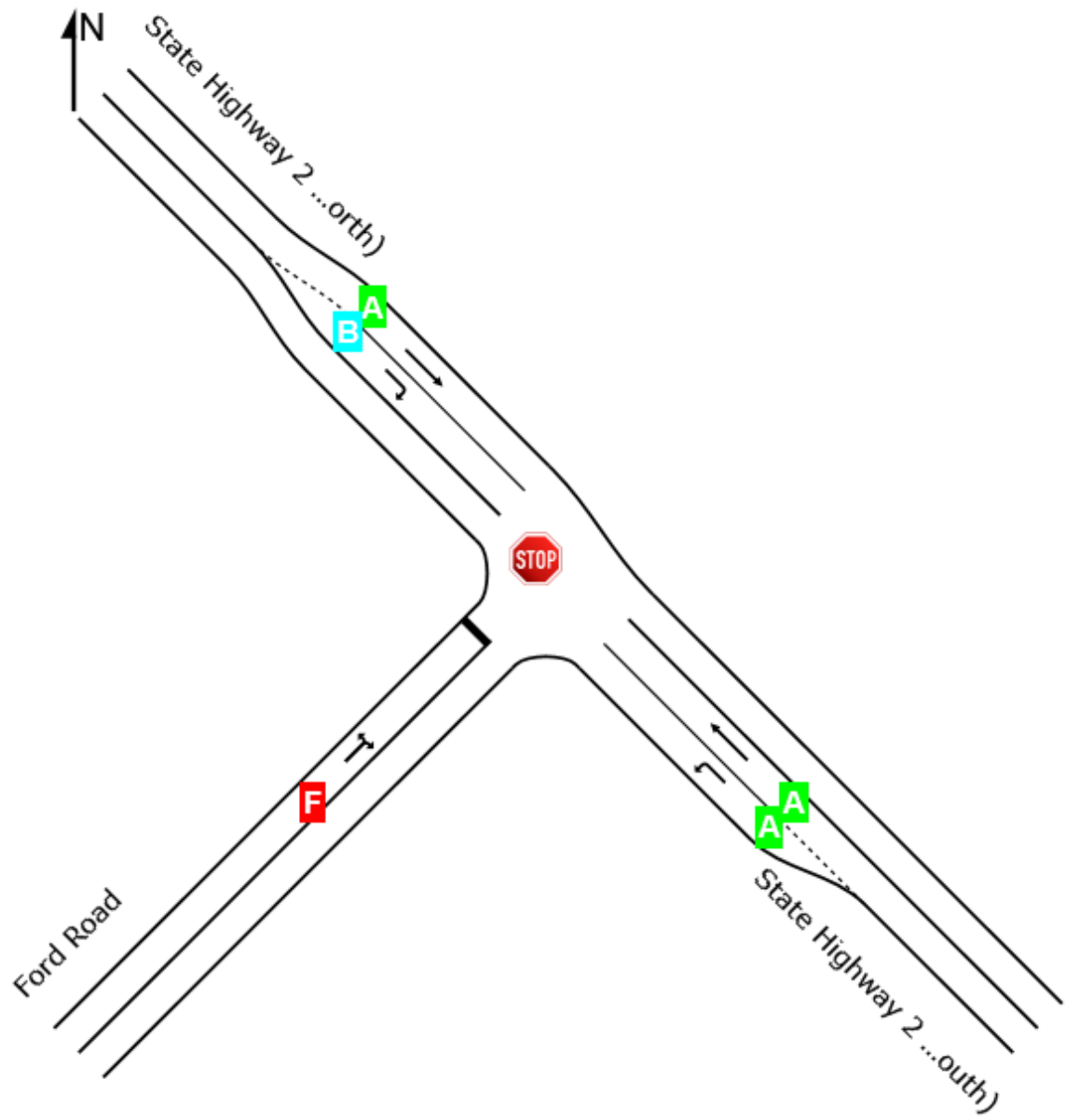
Lane Level of Service

 **Site: 101v [SH2_Ford_AM_2020 +HD (Site Folder: Version 28/05/2024 (Plus High Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	F	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_PM_2020 +HD (Site Folder: Version 28/05/2024 (Plus High Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	83.8	83.8 km/h
Travel Distance (Total)	veh-km/h	1273.8	1528.5 pers-km/h
Travel Time (Total)	veh-h/h	15.2	18.2 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.84	
Travel Time Index		8.20	
Congestion Coefficient		1.19	
Demand Flows (Total)	veh/h	1260	1512 pers/h
Arrival Flows (Total)	veh/h	1260	
Percent Heavy Vehicles (Demand)	%	13.1	
Percent Heavy Vehicles (Arrivals)	%	13.1	
Degree of Saturation		0.421	
Practical Spare Capacity	%	90.0	
Effective Intersection Capacity	veh/h	2993	
Control Delay (Total)	veh-h/h	1.63	1.96 pers-h/h
Control Delay (Average)	sec	4.7	4.7 sec
Control Delay (Worst Lane by MC)	sec	25.6	
Control Delay (Worst Movement by MC)	sec	164.2	164.2 sec
Geometric Delay (Average)	sec	2.7	
Stop-Line Delay (Average)	sec	1.9	
Idling Time (Average)	sec	1.3	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	2.0	
95% Back of Queue - Dist (Worst Lane)	m	14.3	
Ave. Que Storage Ratio (Worst Lane)		0.01	
Effective Stops (Total)	veh/h	320	384 pers/h
Effective Stop Rate		0.25	0.25
Proportion Queued		0.15	0.15
Performance Index		20.1	20.1
Cost (Total)	\$/h	872.71	872.71 \$/h
Fuel Consumption (Total)	L/h	169.3	
Carbon Dioxide (Total)	kg/h	408.9	
Hydrocarbons (Total)	kg/h	0.043	
Carbon Monoxide (Total)	kg/h	0.82	
NOx (Total)	kg/h	1.284	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 83.8% 47.1% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	604,800	725,760 pers/y
Delay (Total)	veh-h/y	782	939 pers-h/y

Effective Stops (Total)	veh/y	153,775	184,530 pers/y
Travel Distance (Total)	veh-km/y	611,407	733,689 pers-km/y
Travel Time (Total)	veh-h/y	7,300	8,759 pers-h/y
Cost (Total)	\$/y	418,902	418,902 \$/y
Fuel Consumption (Total)	L/y	81,262	
Carbon Dioxide (Total)	kg/y	196,268	
Hydrocarbons (Total)	kg/y	21	
Carbon Monoxide (Total)	kg/y	392	
NOx (Total)	kg/y	616	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

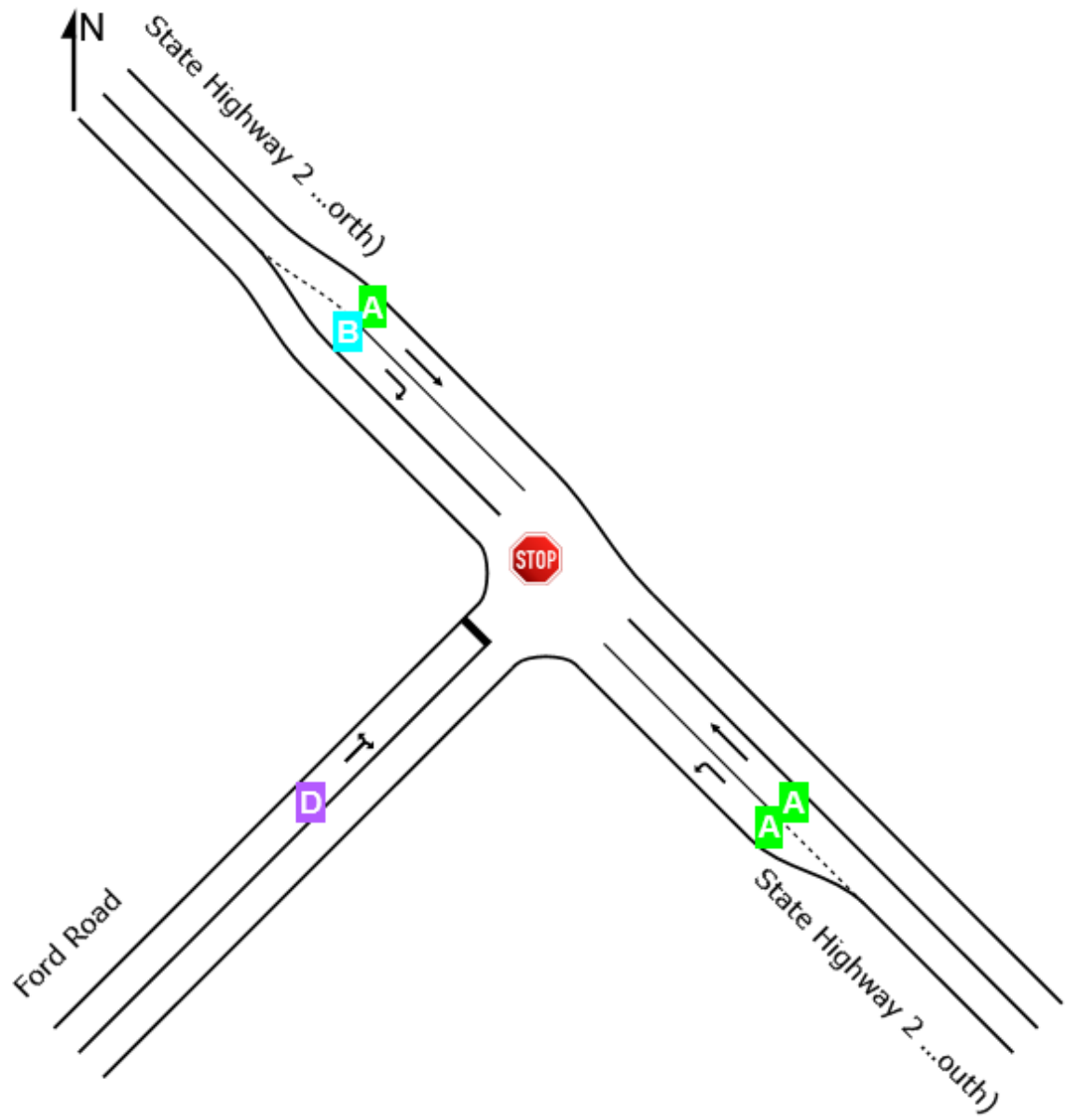
Lane Level of Service

 Site: 101v [SH2_Ford_PM_2020 +HD (Site Folder: Version 28/05/2024 (Plus High Development))]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	D	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_AM_2028 +LD (Site Folder: Version 28/05/2024 (Plus Low Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	78.0	78.0 km/h
Travel Distance (Total)	veh-km/h	1280.1	1536.2 pers-km/h
Travel Time (Total)	veh-h/h	16.4	19.7 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.78	
Travel Time Index		7.56	
Congestion Coefficient		1.28	
Demand Flows (Total)	veh/h	1266	1520 pers/h
Arrival Flows (Total)	veh/h	1266	
Percent Heavy Vehicles (Demand)	%	12.6	
Percent Heavy Vehicles (Arrivals)	%	12.6	
Degree of Saturation		0.865	
Practical Spare Capacity	%	-7.6	
Effective Intersection Capacity	veh/h	1463	
Control Delay (Total)	veh-h/h	3.15	3.78 pers-h/h
Control Delay (Average)	sec	9.0	9.0 sec
Control Delay (Worst Lane by MC)	sec	51.1	
Control Delay (Worst Movement by MC)	sec	185.8	185.8 sec
Geometric Delay (Average)	sec	2.1	
Stop-Line Delay (Average)	sec	6.9	
Idling Time (Average)	sec	5.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	6.2	
95% Back of Queue - Dist (Worst Lane)	m	45.0	
Ave. Que Storage Ratio (Worst Lane)		0.04	
Effective Stops (Total)	veh/h	337	405 pers/h
Effective Stop Rate		0.27	0.27
Proportion Queued		0.18	0.18
Performance Index		28.1	28.1
Cost (Total)	\$/h	864.02	864.02 \$/h
Fuel Consumption (Total)	L/h	158.0	
Carbon Dioxide (Total)	kg/h	381.5	
Hydrocarbons (Total)	kg/h	0.041	
Carbon Monoxide (Total)	kg/h	0.80	
NOx (Total)	kg/h	1.105	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 87.1% 72.6% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	607,832	729,398 pers/y
Delay (Total)	veh-h/y	1,513	1,816 pers-h/y

Effective Stops (Total)	veh/y	161,932	194,319 pers/y
Travel Distance (Total)	veh-km/y	614,469	737,362 pers-km/y
Travel Time (Total)	veh-h/y	7,875	9,450 pers-h/y
Cost (Total)	\$/y	414,732	414,732 \$/y
Fuel Consumption (Total)	L/y	75,863	
Carbon Dioxide (Total)	kg/y	183,100	
Hydrocarbons (Total)	kg/y	20	
Carbon Monoxide (Total)	kg/y	384	
NOx (Total)	kg/y	530	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

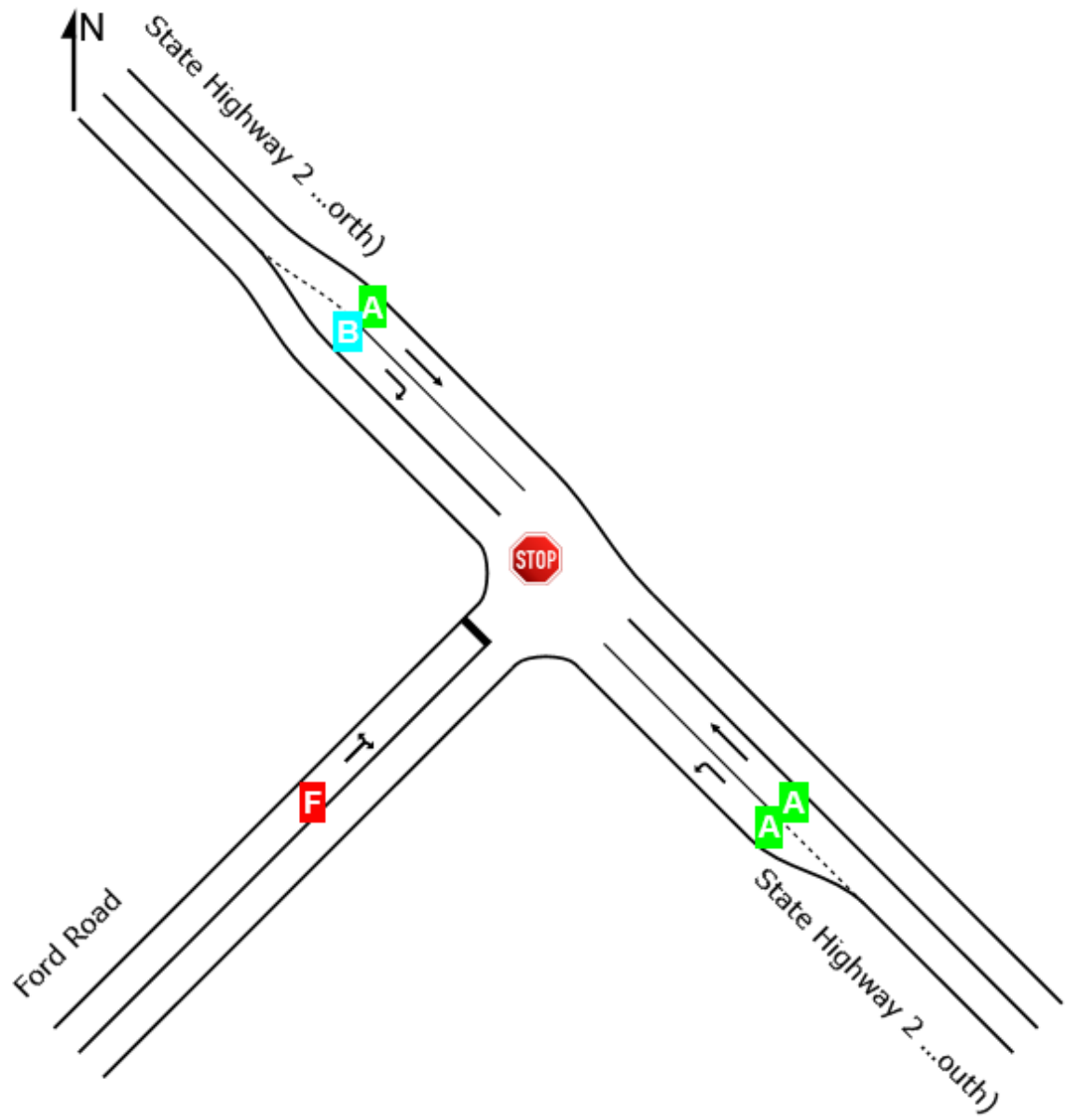
Lane Level of Service

 **Site: 101v [SH2_Ford_AM_2028 +LD (Site Folder: Version 28/05/2024 (Plus Low Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	F	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_PM_2028 +LD (Site Folder: Version 28/05/2024 (Plus Low Development))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	87.8	87.8 km/h
Travel Distance (Total)	veh-km/h	1279.8	1535.8 pers-km/h
Travel Time (Total)	veh-h/h	14.6	17.5 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.88	
Travel Time Index		8.64	
Congestion Coefficient		1.14	
Demand Flows (Total)	veh/h	1266	1520 pers/h
Arrival Flows (Total)	veh/h	1266	
Percent Heavy Vehicles (Demand)	%	13.4	
Percent Heavy Vehicles (Arrivals)	%	13.4	
Degree of Saturation		0.384	
Practical Spare Capacity	%	124.6	
Effective Intersection Capacity	veh/h	3298	
Control Delay (Total)	veh-h/h	1.19	1.43 pers-h/h
Control Delay (Average)	sec	3.4	3.4 sec
Control Delay (Worst Lane by MC)	sec	27.1	
Control Delay (Worst Movement by MC)	sec	198.0	198.0 sec
Geometric Delay (Average)	sec	1.9	
Stop-Line Delay (Average)	sec	1.5	
Idling Time (Average)	sec	1.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	1.4	
95% Back of Queue - Dist (Worst Lane)	m	10.1	
Ave. Queue Storage Ratio (Worst Lane)		0.01	
Effective Stops (Total)	veh/h	227	272 pers/h
Effective Stop Rate		0.18	0.18
Proportion Queued		0.11	0.11
Performance Index		18.0	18.0
Cost (Total)	\$/h	828.17	828.17 \$/h
Fuel Consumption (Total)	L/h	159.6	
Carbon Dioxide (Total)	kg/h	386.0	
Hydrocarbons (Total)	kg/h	0.041	
Carbon Monoxide (Total)	kg/h	0.80	
NOx (Total)	kg/h	1.211	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 86.5% 48.2% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	607,832	729,398 pers/y
Delay (Total)	veh-h/y	570	684 pers-h/y

Effective Stops (Total)	veh/y	108,727	130,472 pers/y
Travel Distance (Total)	veh-km/y	614,304	737,165 pers-km/y
Travel Time (Total)	veh-h/y	6,999	8,398 pers-h/y
Cost (Total)	\$/y	397,522	397,522 \$/y
Fuel Consumption (Total)	L/y	76,606	
Carbon Dioxide (Total)	kg/y	185,271	
Hydrocarbons (Total)	kg/y	19	
Carbon Monoxide (Total)	kg/y	382	
NOx (Total)	kg/y	581	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

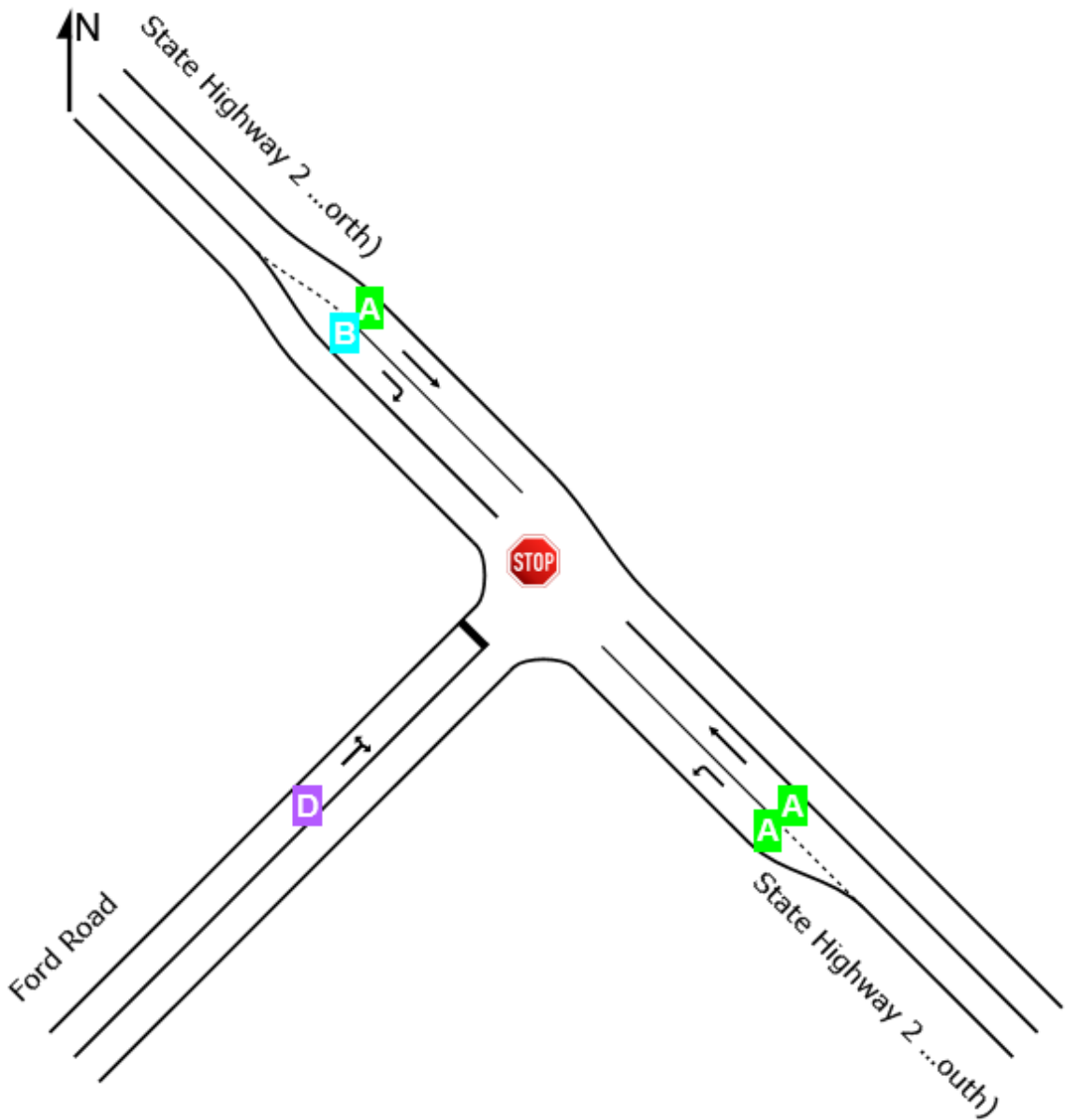
Lane Level of Service

 Site: 101v [SH2_Ford_PM_2028 +LD (Site Folder: Version 28/05/2024 (Plus Low Development))]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	D	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_AM_2043 (Site Folder: Version 28/05/2024 (Standard 2% growth))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	95.8	95.8 km/h
Travel Distance (Total)	veh-km/h	1375.9	1651.1 pers-km/h
Travel Time (Total)	veh-h/h	14.4	17.2 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.96	
Travel Time Index		9.53	
Congestion Coefficient		1.04	
Demand Flows (Total)	veh/h	1362	1635 pers/h
Arrival Flows (Total)	veh/h	1362	
Percent Heavy Vehicles (Demand)	%	13.8	
Percent Heavy Vehicles (Arrivals)	%	13.8	
Degree of Saturation		0.516	
Practical Spare Capacity	%	89.7	
Effective Intersection Capacity	veh/h	2637	
Control Delay (Total)	veh-h/h	0.51	0.62 pers-h/h
Control Delay (Average)	sec	1.4	1.4 sec
Control Delay (Worst Lane by MC)	sec	51.0	
Control Delay (Worst Movement by MC)	sec	441.9	441.9 sec
Geometric Delay (Average)	sec	0.3	
Stop-Line Delay (Average)	sec	1.1	
Idling Time (Average)	sec	0.9	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.9	
95% Back of Queue - Dist (Worst Lane)	m	6.3	
Ave. Que Storage Ratio (Worst Lane)		0.01	
Effective Stops (Total)	veh/h	42	50 pers/h
Effective Stop Rate		0.03	0.03
Proportion Queued		0.03	0.03
Performance Index		16.0	16.0
Cost (Total)	\$/h	788.63	788.63 \$/h
Fuel Consumption (Total)	L/h	148.6	
Carbon Dioxide (Total)	kg/h	360.5	
Hydrocarbons (Total)	kg/h	0.038	
Carbon Monoxide (Total)	kg/h	0.80	
NOx (Total)	kg/h	1.116	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 94.7% 84.7% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	653,811	784,573 pers/y
Delay (Total)	veh-h/y	246	295 pers-h/y

Effective Stops (Total)	veh/y	20,097	24,116 pers/y
Travel Distance (Total)	veh-km/y	660,434	792,521 pers-km/y
Travel Time (Total)	veh-h/y	6,894	8,272 pers-h/y
Cost (Total)	\$/y	378,540	378,540 \$/y
Fuel Consumption (Total)	L/y	71,326	
Carbon Dioxide (Total)	kg/y	173,019	
Hydrocarbons (Total)	kg/y	18	
Carbon Monoxide (Total)	kg/y	385	
NOx (Total)	kg/y	535	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

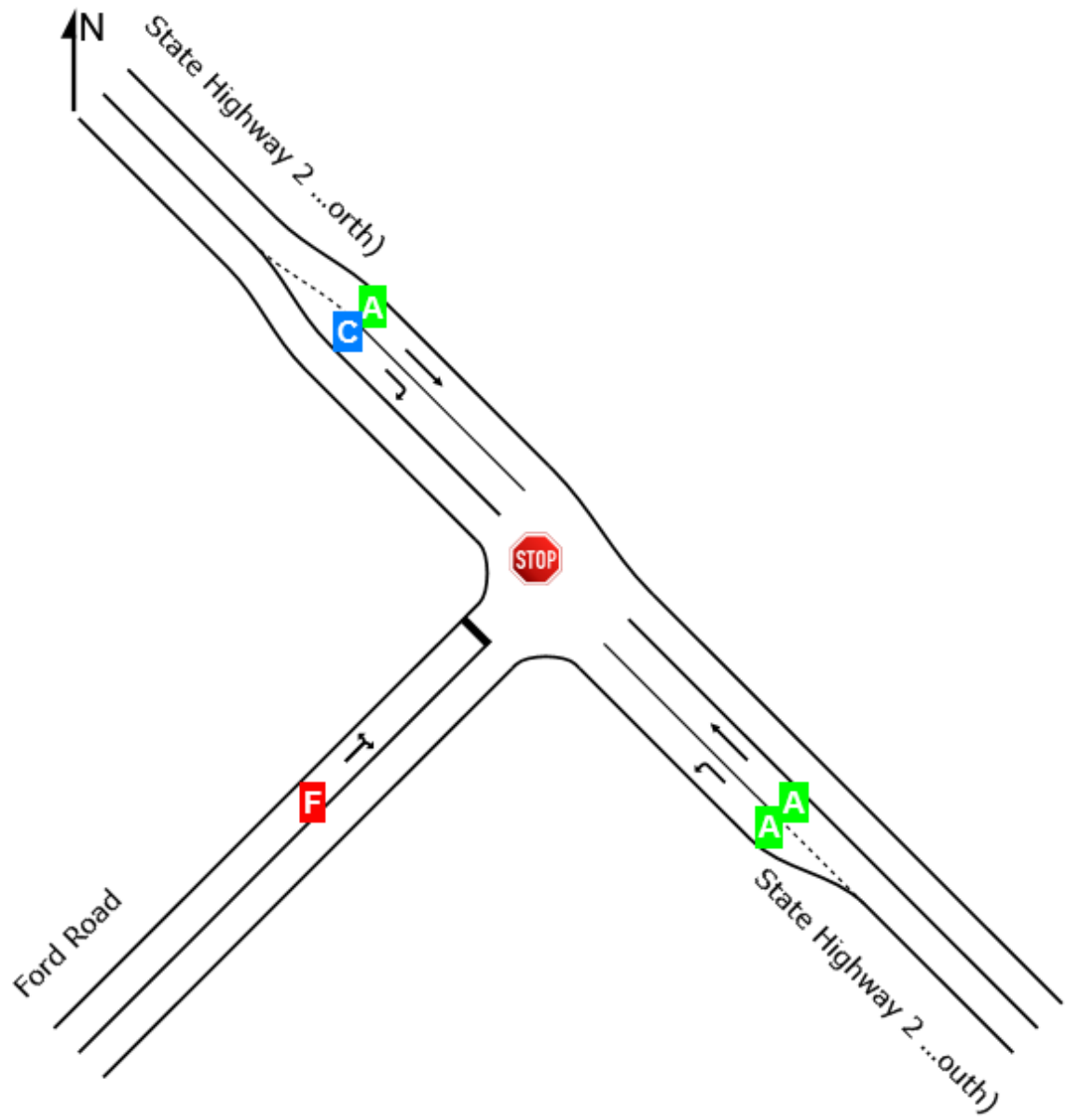
Lane Level of Service

 **Site: 101v [SH2_Ford_AM_2043 (Site Folder: Version 28/05/2024 (Standard 2% growth))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	F	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 **Site: 101v [SH2_Ford_PM_2043 (Site Folder: Version 28/05/2024 (Standard 2% growth))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site

Site Category: (None)

Stop (Two-Way)

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	97.5	97.5 km/h
Travel Distance (Total)	veh-km/h	1375.9	1651.0 pers-km/h
Travel Time (Total)	veh-h/h	14.1	16.9 pers-h/h
Desired Speed	km/h	100.0	
Speed Efficiency		0.98	
Travel Time Index		9.72	
Congestion Coefficient		1.03	
Demand Flows (Total)	veh/h	1362	1635 pers/h
Arrival Flows (Total)	veh/h	1362	
Percent Heavy Vehicles (Demand)	%	13.9	
Percent Heavy Vehicles (Arrivals)	%	13.9	
Degree of Saturation		0.516	
Practical Spare Capacity	%	89.7	
Effective Intersection Capacity	veh/h	2637	
Control Delay (Total)	veh-h/h	0.24	0.29 pers-h/h
Control Delay (Average)	sec	0.6	0.6 sec
Control Delay (Worst Lane by MC)	sec	38.2	
Control Delay (Worst Movement by MC)	sec	400.7	400.7 sec
Geometric Delay (Average)	sec	0.3	
Stop-Line Delay (Average)	sec	0.4	
Idling Time (Average)	sec	0.3	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.3	
95% Back of Queue - Dist (Worst Lane)	m	2.0	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	33	40 pers/h
Effective Stop Rate		0.02	0.02
Proportion Queued		0.01	0.01
Performance Index		14.7	14.7
Cost (Total)	\$/h	784.01	784.01 \$/h
Fuel Consumption (Total)	L/h	148.9	
Carbon Dioxide (Total)	kg/h	361.4	
Hydrocarbons (Total)	kg/h	0.038	
Carbon Monoxide (Total)	kg/h	0.80	
NOx (Total)	kg/h	1.133	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 93.7% 52.5% 0.0%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	653,811	784,573 pers/y
Delay (Total)	veh-h/y	115	137 pers-h/y

Effective Stops (Total)	veh/y	16,072	19,286 pers/y
Travel Distance (Total)	veh-km/y	660,408	792,489 pers-km/y
Travel Time (Total)	veh-h/y	6,772	8,127 pers-h/y
Cost (Total)	\$/y	376,326	376,326 \$/y
Fuel Consumption (Total)	L/y	71,483	
Carbon Dioxide (Total)	kg/y	173,456	
Hydrocarbons (Total)	kg/y	18	
Carbon Monoxide (Total)	kg/y	384	
NOx (Total)	kg/y	544	

1 Hours per Year: 480 (Site)

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LANE LEVEL OF SERVICE

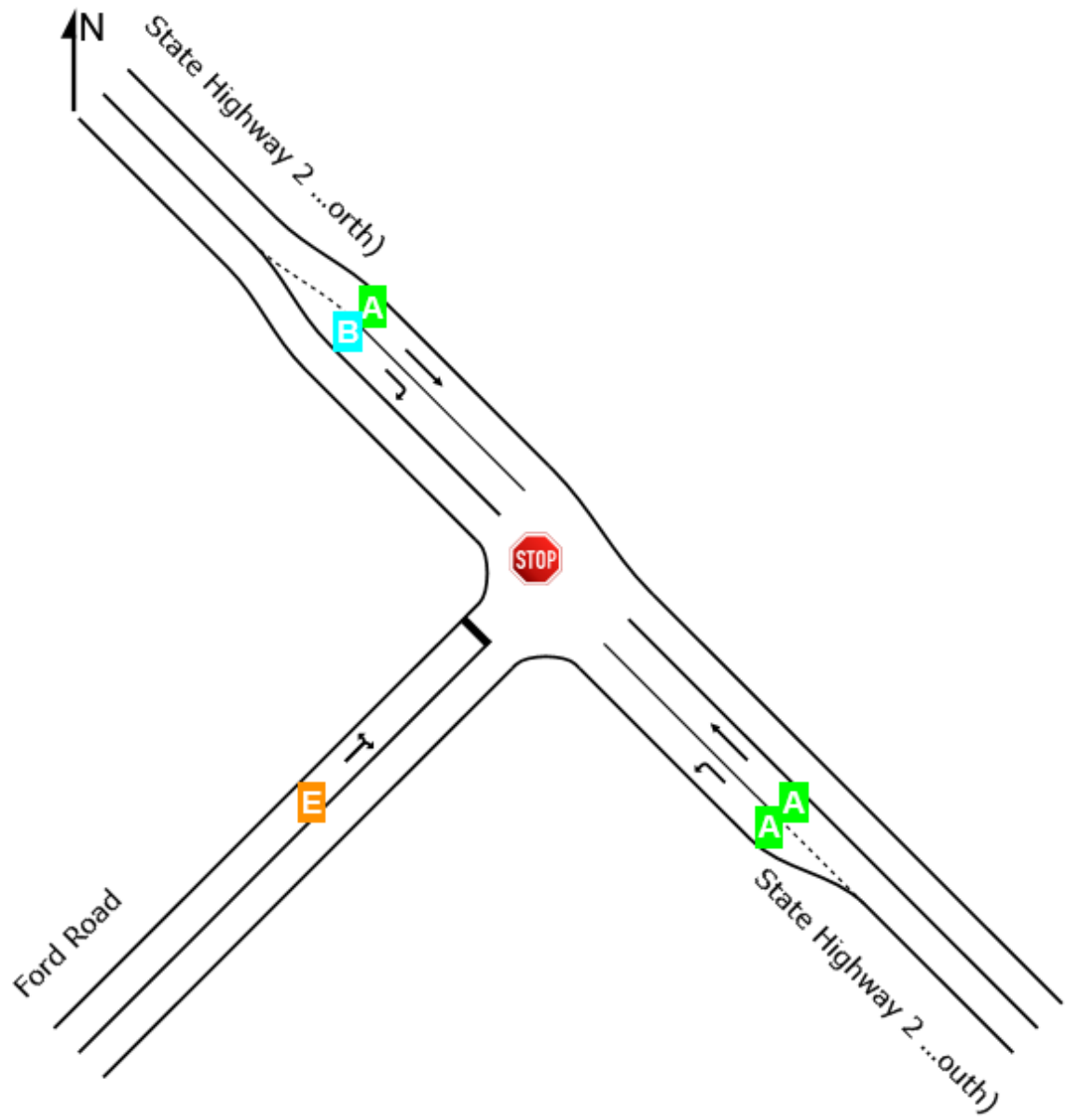
Lane Level of Service

 **Site: 101v [SH2_Ford_PM_2043 (Site Folder: Version 28/05/2024 (Standard 2% growth))]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

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

	Approaches			Intersection
	Southeast	Northwest	Southwest	
LOS	NA (TWSC)	NA (TWSC)	E	NA (TWSC)



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_AM_2019+LD (Site Folder: General)]

Site Category: (None)
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	56.3 km/h	56.3 km/h
Travel Distance (Total)	1609.8 veh-km/h	1931.7 pers-km/h
Travel Time (Total)	28.6 veh-h/h	34.3 pers-h/h
Desired Speed (Program)	68.2 km/h	
Speed Efficiency	0.83	
Travel Time Index	8.06	
Congestion Coefficient	1.21	
Demand Flows (Total)	1543 veh/h	1852 pers/h
Percent Heavy Vehicles (Demand)	10.7 %	
Degree of Saturation	0.548	
Practical Spare Capacity	55.1 %	
Effective Intersection Capacity	2815 veh/h	
Control Delay (Total)	3.67 veh-h/h	4.40 pers-h/h
Control Delay (Average)	8.6 sec	8.6 sec
Control Delay (Worst Lane)	10.7 sec	
Control Delay (Worst Movement)	11.2 sec	11.2 sec
Geometric Delay (Average)	6.4 sec	
Stop-Line Delay (Average)	2.2 sec	
Idling Time (Average)	0.1 sec	
Intersection Level of Service (LOS)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	4.5 veh	
95% Back of Queue - Distance (Worst Lane)	35.2 m	
Ave. Queue Storage Ratio (Worst Lane)	0.03	
Total Effective Stops	1025 veh/h	1230 pers/h
Effective Stop Rate	0.66	0.66
Proportion Queued	0.59	0.59
Performance Index	51.1	51.1
Cost (Total)	1402.07 \$/h	1402.07 \$/h
Fuel Consumption (Total)	242.6 L/h	
Carbon Dioxide (Total)	583.2 kg/h	
Hydrocarbons (Total)	0.053 kg/h	
Carbon Monoxide (Total)	0.786 kg/h	
NOx (Total)	1.893 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.7 %

Number of Iterations: 7 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.0% 1.0% 0.5%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	740,716 veh/y	888,859 pers/y
Delay	1,760 veh-h/y	2,112 pers-h/y
Effective Stops	492,061 veh/y	590,473 pers/y
Travel Distance	772,683 veh-km/y	927,220 pers-km/y
Travel Time	13,721 veh-h/y	16,465 pers-h/y
Cost	672,993 \$/y	672,993 \$/y
Fuel Consumption	116,424 L/y	
Carbon Dioxide	279,922 kg/y	
Hydrocarbons	25 kg/y	

Carbon Monoxide	377 kg/y
NOx	909 kg/y

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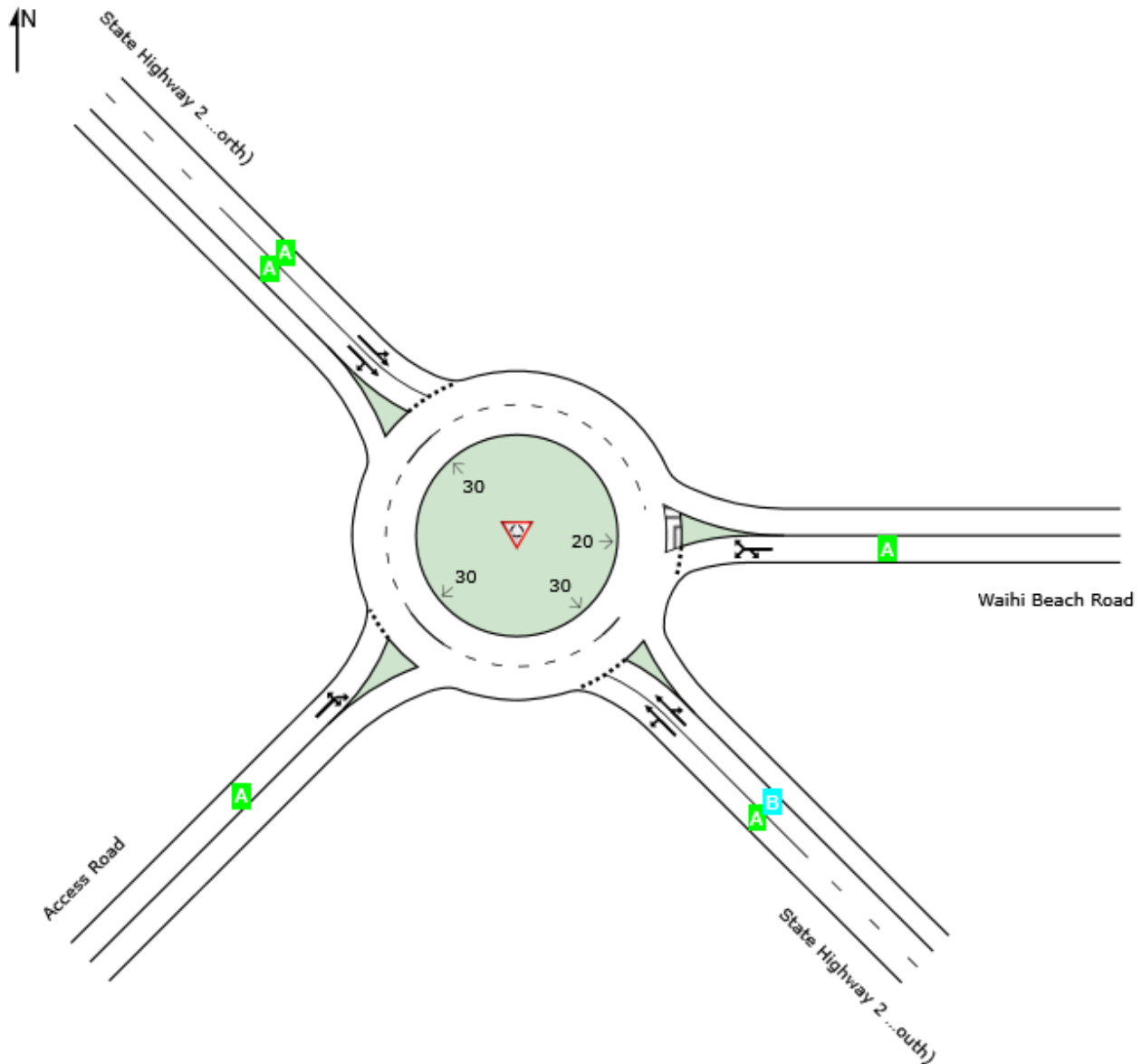
LANE LEVEL OF SERVICE

Lane Level of Service

 Site: 101vvvv [SH2_Waihi_AM_2019+LD (Site Folder: General)]

Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_AM_2048+HD (Site Folder: General)]

Site Category: (None)
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	55.1 km/h	55.1 km/h
Travel Distance (Total)	1741.4 veh-km/h	2089.6 pers-km/h
Travel Time (Total)	31.6 veh-h/h	37.9 pers-h/h
Desired Speed (Program)	66.4 km/h	
Speed Efficiency	0.83	
Travel Time Index	8.11	
Congestion Coefficient	1.21	
Demand Flows (Total)	1669 veh/h	2003 pers/h
Percent Heavy Vehicles (Demand)	10.5 %	
Degree of Saturation	0.605	
Practical Spare Capacity	40.6 %	
Effective Intersection Capacity	2761 veh/h	
Control Delay (Total)	4.23 veh-h/h	5.08 pers-h/h
Control Delay (Average)	9.1 sec	9.1 sec
Control Delay (Worst Lane)	12.1 sec	
Control Delay (Worst Movement)	12.6 sec	12.6 sec
Geometric Delay (Average)	6.2 sec	
Stop-Line Delay (Average)	2.9 sec	
Idling Time (Average)	0.1 sec	
Intersection Level of Service (LOS)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	5.8 veh	
95% Back of Queue - Distance (Worst Lane)	45.2 m	
Ave. Queue Storage Ratio (Worst Lane)	0.04	
Total Effective Stops	1194 veh/h	1433 pers/h
Effective Stop Rate	0.72	0.72
Proportion Queued	0.65	0.65
Performance Index	59.9	59.9
Cost (Total)	1518.22 \$/h	1518.22 \$/h
Fuel Consumption (Total)	258.1 L/h	
Carbon Dioxide (Total)	620.4 kg/h	
Hydrocarbons (Total)	0.056 kg/h	
Carbon Monoxide (Total)	0.818 kg/h	
NOx (Total)	2.004 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 3.7 %

Number of Iterations: 7 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.9% 1.5% 0.8%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	801,347 veh/y	961,617 pers/y
Delay	2,031 veh-h/y	2,438 pers-h/y
Effective Stops	573,279 veh/y	687,935 pers/y
Travel Distance	835,851 veh-km/y	1,003,021 pers-km/y
Travel Time	15,167 veh-h/y	18,201 pers-h/y
Cost	728,746 \$/y	728,746 \$/y
Fuel Consumption	123,878 L/y	
Carbon Dioxide	297,801 kg/y	
Hydrocarbons	27 kg/y	

Carbon Monoxide	392 kg/y
NOx	962 kg/y

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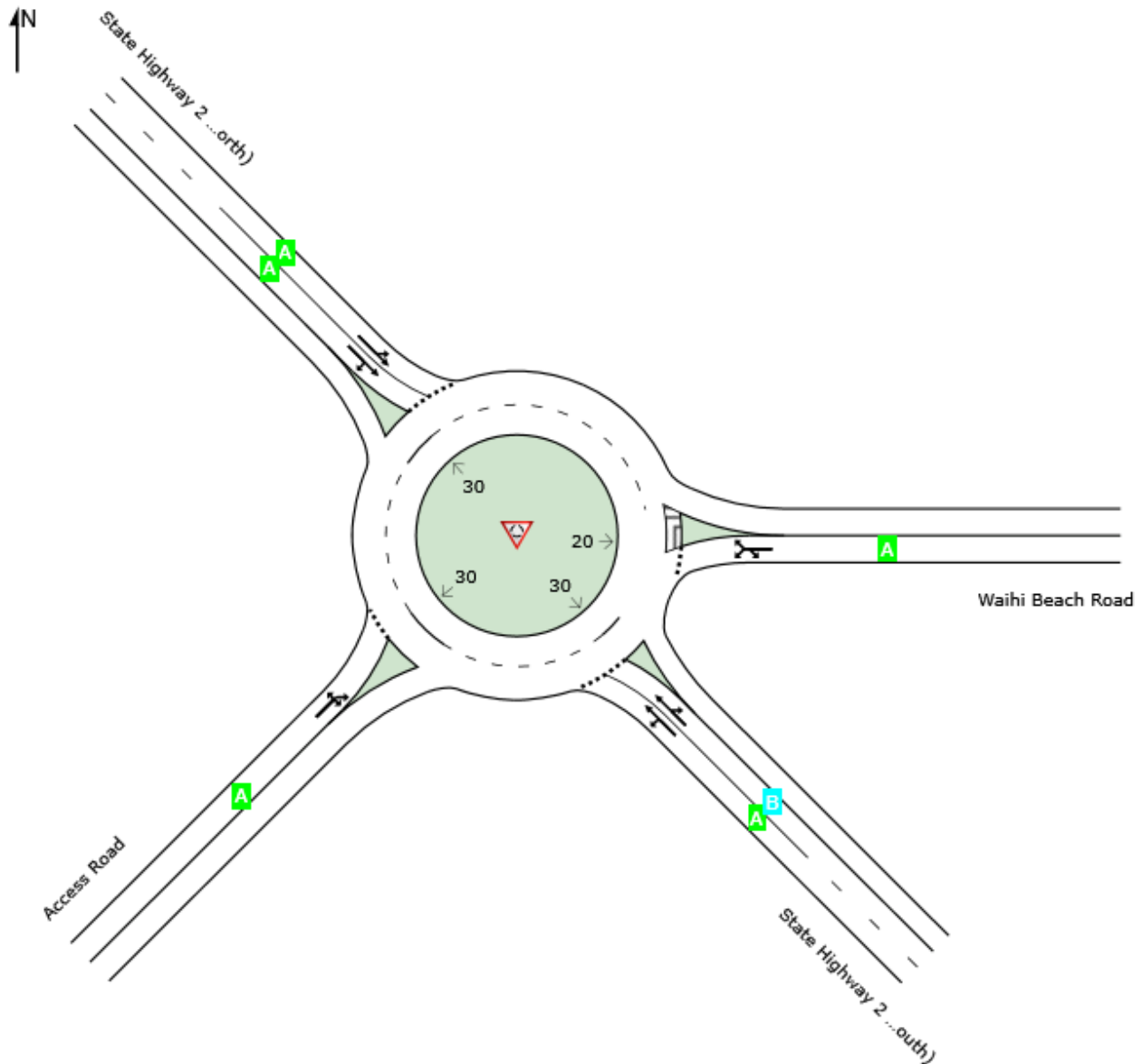
LANE LEVEL OF SERVICE

Lane Level of Service

 Site: 101vvvv [SH2_Waihi_AM_2048+HD (Site Folder: General)]

Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_PM_2019+LD (Site Folder: General)]

Site Category: (None)
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	56.6 km/h	56.6 km/h
Travel Distance (Total)	1616.4 veh-km/h	1939.7 pers-km/h
Travel Time (Total)	28.6 veh-h/h	34.3 pers-h/h
Desired Speed (Program)	68.1 km/h	
Speed Efficiency	0.83	
Travel Time Index	8.12	
Congestion Coefficient	1.20	
Demand Flows (Total)	1543 veh/h	1852 pers/h
Percent Heavy Vehicles (Demand)	11.1 %	
Degree of Saturation	0.469	
Practical Spare Capacity	81.3 %	
Effective Intersection Capacity	3291 veh/h	
Control Delay (Total)	3.64 veh-h/h	4.37 pers-h/h
Control Delay (Average)	8.5 sec	8.5 sec
Control Delay (Worst Lane)	9.9 sec	
Control Delay (Worst Movement)	11.1 sec	11.1 sec
Geometric Delay (Average)	6.7 sec	
Stop-Line Delay (Average)	1.8 sec	
Idling Time (Average)	0.1 sec	
Intersection Level of Service (LOS)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	3.6 veh	
95% Back of Queue - Distance (Worst Lane)	28.4 m	
Ave. Queue Storage Ratio (Worst Lane)	0.02	
Total Effective Stops	992 veh/h	1190 pers/h
Effective Stop Rate	0.64	0.64
Proportion Queued	0.52	0.52
Performance Index	49.0	49.0
Cost (Total)	1406.84 \$/h	1406.84 \$/h
Fuel Consumption (Total)	244.3 L/h	
Carbon Dioxide (Total)	587.6 kg/h	
Hydrocarbons (Total)	0.053 kg/h	
Carbon Monoxide (Total)	0.789 kg/h	
NOx (Total)	1.918 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.2 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.6% 1.4% 0.7%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	740,716 veh/y	888,859 pers/y
Delay	1,748 veh-h/y	2,098 pers-h/y
Effective Stops	476,096 veh/y	571,315 pers/y
Travel Distance	775,860 veh-km/y	931,032 pers-km/y
Travel Time	13,707 veh-h/y	16,448 pers-h/y
Cost	675,285 \$/y	675,285 \$/y
Fuel Consumption	117,256 L/y	
Carbon Dioxide	282,036 kg/y	
Hydrocarbons	25 kg/y	

Carbon Monoxide	379 kg/y
NOx	921 kg/y

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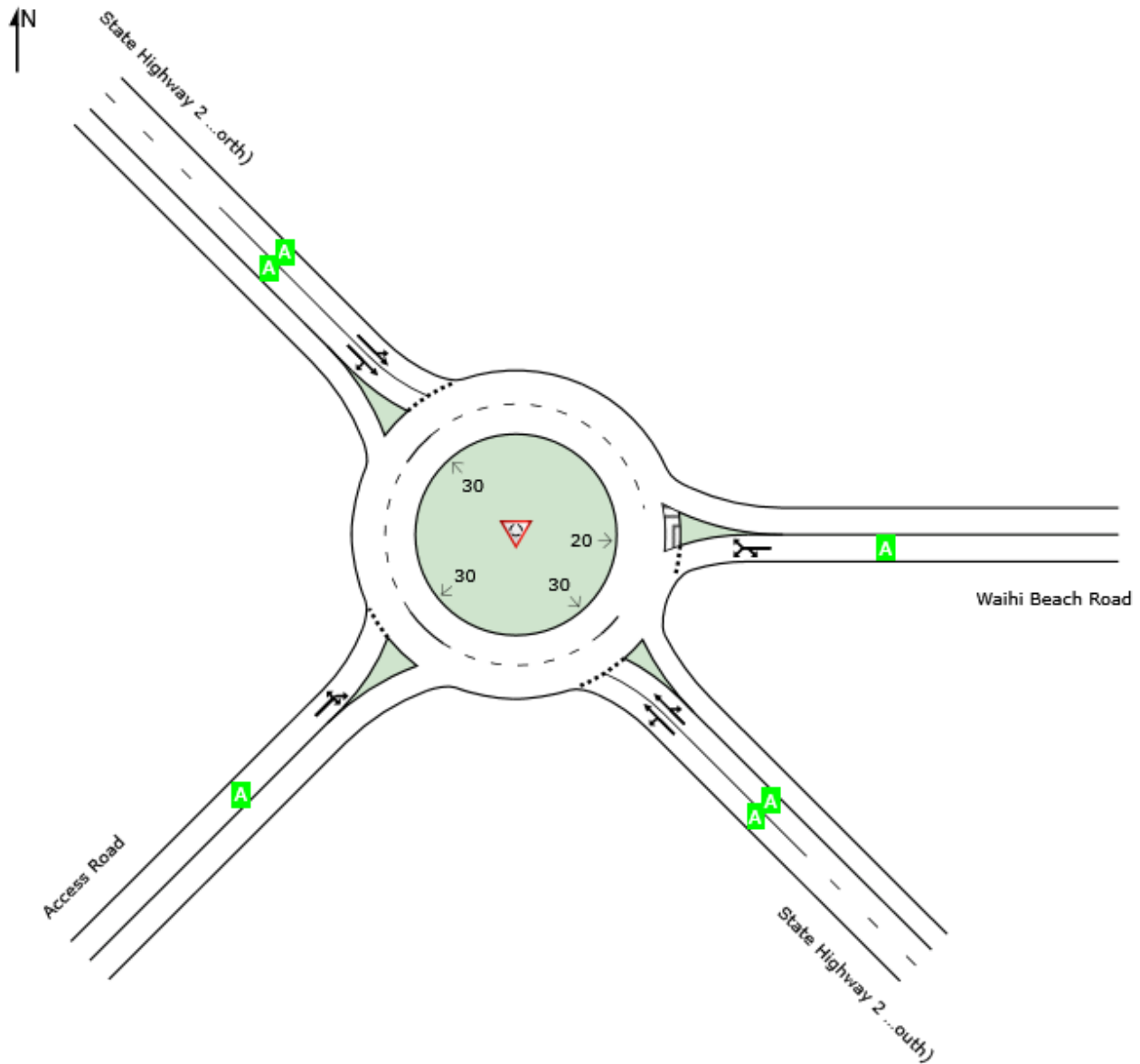
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101vvvv [SH2_Waihi_PM_2019+LD (Site Folder: General)]**

Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	A	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_PM_2048+HD (Site Folder: General)]

Site Category: (None)
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	55.3 km/h	55.3 km/h
Travel Distance (Total)	1748.5 veh-km/h	2098.2 pers-km/h
Travel Time (Total)	31.6 veh-h/h	38.0 pers-h/h
Desired Speed (Program)	66.3 km/h	
Speed Efficiency	0.83	
Travel Time Index	8.15	
Congestion Coefficient	1.20	
Demand Flows (Total)	1669 veh/h	2003 pers/h
Percent Heavy Vehicles (Demand)	10.7 %	
Degree of Saturation	0.491	
Practical Spare Capacity	73.2 %	
Effective Intersection Capacity	3403 veh/h	
Control Delay (Total)	4.15 veh-h/h	4.98 pers-h/h
Control Delay (Average)	8.9 sec	8.9 sec
Control Delay (Worst Lane)	10.5 sec	
Control Delay (Worst Movement)	12.3 sec	12.3 sec
Geometric Delay (Average)	6.5 sec	
Stop-Line Delay (Average)	2.4 sec	
Idling Time (Average)	0.2 sec	
Intersection Level of Service (LOS)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	3.8 veh	
95% Back of Queue - Distance (Worst Lane)	30.1 m	
Ave. Queue Storage Ratio (Worst Lane)	0.02	
Total Effective Stops	1152 veh/h	1383 pers/h
Effective Stop Rate	0.69	0.69
Proportion Queued	0.58	0.58
Performance Index	57.0	57.0
Cost (Total)	1521.63 \$/h	1521.63 \$/h
Fuel Consumption (Total)	258.9 L/h	
Carbon Dioxide (Total)	622.5 kg/h	
Hydrocarbons (Total)	0.056 kg/h	
Carbon Monoxide (Total)	0.818 kg/h	
NOx (Total)	1.999 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.4 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.5% 0.8%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	801,348 veh/y	961,617 pers/y
Delay	1,991 veh-h/y	2,389 pers-h/y
Effective Stops	553,105 veh/y	663,727 pers/y
Travel Distance	839,265 veh-km/y	1,007,118 pers-km/y
Travel Time	15,184 veh-h/y	18,221 pers-h/y
Cost	730,382 \$/y	730,382 \$/y
Fuel Consumption	124,275 L/y	
Carbon Dioxide	298,780 kg/y	
Hydrocarbons	27 kg/y	

Carbon Monoxide	393 kg/y
NOx	960 kg/y

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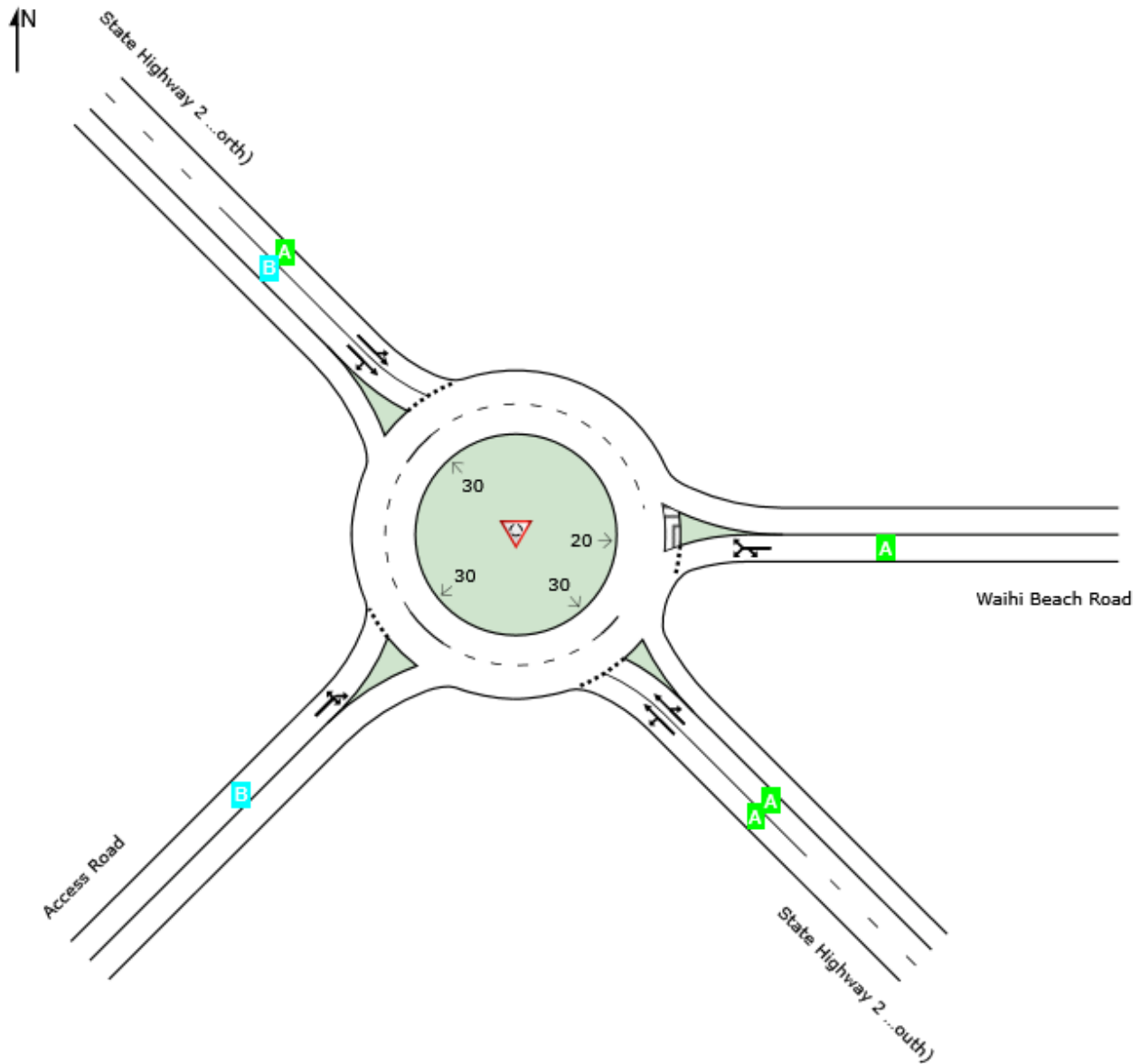
LANE LEVEL OF SERVICE

Lane Level of Service

 Site: 101vvvv [SH2_Waihi_PM_2048+HD (Site Folder: General)]

Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	A	A	A	B	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_AM_2020+HD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	53.3	53.3 km/h
Travel Distance (Total)	veh-km/h	1764.4	2117.3 pers-km/h
Travel Time (Total)	veh-h/h	33.1	39.7 pers-h/h
Desired Speed	km/h	66.5	
Speed Efficiency		0.80	
Travel Time Index		7.79	
Congestion Coefficient		1.25	
Demand Flows (Total)	veh/h	1692	2030 pers/h
Arrival Flows (Total)	veh/h	1692	
Percent Heavy Vehicles (Demand)	%	10.5	
Percent Heavy Vehicles (Arrivals)	%	10.5	
Degree of Saturation		0.622	
Practical Spare Capacity	%	36.6	
Effective Intersection Capacity	veh/h	2719	
Control Delay (Total)	veh-h/h	4.38	5.25 pers-h/h
Control Delay (Average)	sec	9.3	9.3 sec
Control Delay (Worst Lane by MC)	sec	12.5	
Control Delay (Worst Movement by MC)	sec	15.4	15.4 sec
Geometric Delay (Average)	sec	6.2	
Stop-Line Delay (Average)	sec	3.1	
Idling Time (Average)	sec	0.2	
Intersection Level of Service (LOS)		LOS A	
95% Back of Queue - Veh (Worst Lane)	veh	6.1	
95% Back of Queue - Dist (Worst Lane)	m	48.1	
Ave. Que Storage Ratio (Worst Lane)		0.04	
Effective Stops (Total)	veh/h	1101	1321 pers/h
Effective Stop Rate		0.65	0.65
Proportion Queued		0.66	0.66
Performance Index		60.7	60.7
Cost (Total)	\$/h	1564.49	1564.49 \$/h
Fuel Consumption (Total)	L/h	262.2	
Carbon Dioxide (Total)	kg/h	630.3	
Hydrocarbons (Total)	kg/h	0.057	
Carbon Monoxide (Total)	kg/h	0.83	
NOx (Total)	kg/h	2.038	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 3.8 %

Number of Iterations: 7 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.0% 1.6% 0.8%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	811,958	974,350 pers/y
Delay (Total)	veh-h/y	2,101	2,521 pers-h/y

Effective Stops (Total)	veh/y	528,359	634,031 pers/y
Travel Distance (Total)	veh-km/y	846,900	1,016,280 pers-km/y
Travel Time (Total)	veh-h/y	15,885	19,061 pers-h/y
Cost (Total)	\$/y	750,956	750,956 \$/y
Fuel Consumption (Total)	L/y	125,845	
Carbon Dioxide (Total)	kg/y	302,530	
Hydrocarbons (Total)	kg/y	27	
Carbon Monoxide (Total)	kg/y	399	
NOx (Total)	kg/y	978	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

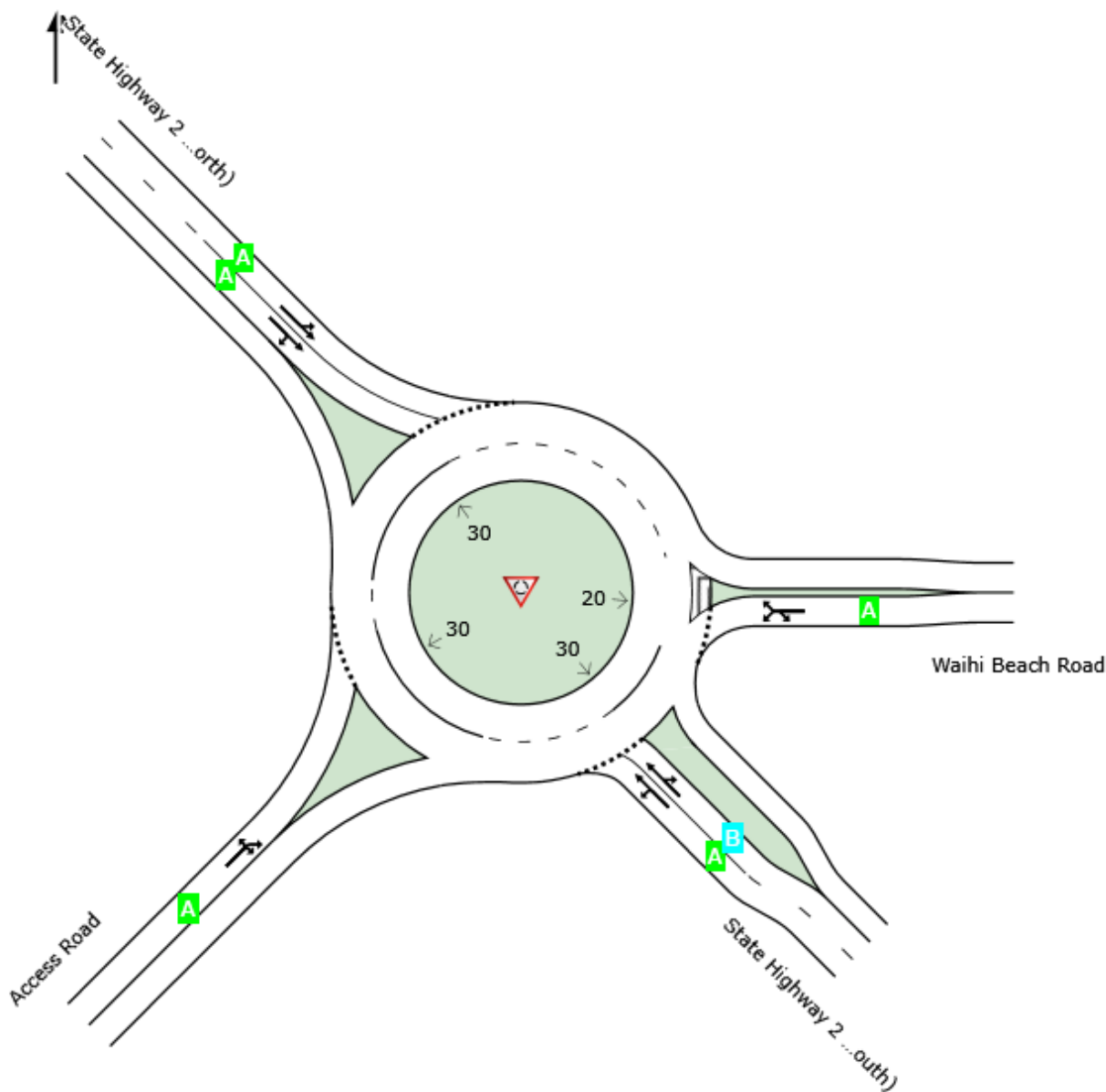
Lane Level of Service

 Site: 101vvvv [SH2_Waihi_AM_2020+HD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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Project: \\ttgroup.local\corporate\Hamilton\Projects\1012502\1012502.5000\WorkingMaterial\modelling\W2_SH2_Waihi_Roundabout.sip9

INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_PM_2020+HD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	53.2	53.2 km/h
Travel Distance (Total)	veh-km/h	1771.7	2126.0 pers-km/h
Travel Time (Total)	veh-h/h	33.3	39.9 pers-h/h
Desired Speed	km/h	66.5	
Speed Efficiency		0.80	
Travel Time Index		7.79	
Congestion Coefficient		1.25	
Demand Flows (Total)	veh/h	1692	2030 pers/h
Arrival Flows (Total)	veh/h	1692	
Percent Heavy Vehicles (Demand)	%	10.7	
Percent Heavy Vehicles (Arrivals)	%	10.7	
Degree of Saturation		0.501	
Practical Spare Capacity	%	69.7	
Effective Intersection Capacity	veh/h	3377	
Control Delay (Total)	veh-h/h	4.25	5.10 pers-h/h
Control Delay (Average)	sec	9.0	9.0 sec
Control Delay (Worst Lane by MC)	sec	10.8	
Control Delay (Worst Movement by MC)	sec	16.4	16.4 sec
Geometric Delay (Average)	sec	6.5	
Stop-Line Delay (Average)	sec	2.5	
Idling Time (Average)	sec	0.2	
Intersection Level of Service (LOS)		LOS A	
95% Back of Queue - Veh (Worst Lane)	veh	4.0	
95% Back of Queue - Dist (Worst Lane)	m	31.0	
Ave. Que Storage Ratio (Worst Lane)		0.02	
Effective Stops (Total)	veh/h	1074	1289 pers/h
Effective Stop Rate		0.64	0.64
Proportion Queued		0.59	0.59
Performance Index		57.5	57.5
Cost (Total)	\$/h	1571.47	1571.47 \$/h
Fuel Consumption (Total)	L/h	263.1	
Carbon Dioxide (Total)	kg/h	632.5	
Hydrocarbons (Total)	kg/h	0.057	
Carbon Monoxide (Total)	kg/h	0.83	
NOx (Total)	kg/h	2.034	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 2.4 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.8% 1.5% 0.8%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	811,958	974,350 pers/y
Delay (Total)	veh-h/y	2,040	2,448 pers-h/y

Effective Stops (Total)	veh/y	515,643	618,772 pers/y
Travel Distance (Total)	veh-km/y	850,406	1,020,487 pers-km/y
Travel Time (Total)	veh-h/y	15,974	19,168 pers-h/y
Cost (Total)	\$/y	754,307	754,307 \$/y
Fuel Consumption (Total)	L/y	126,278	
Carbon Dioxide (Total)	kg/y	303,604	
Hydrocarbons (Total)	kg/y	27	
Carbon Monoxide (Total)	kg/y	400	
NOx (Total)	kg/y	976	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

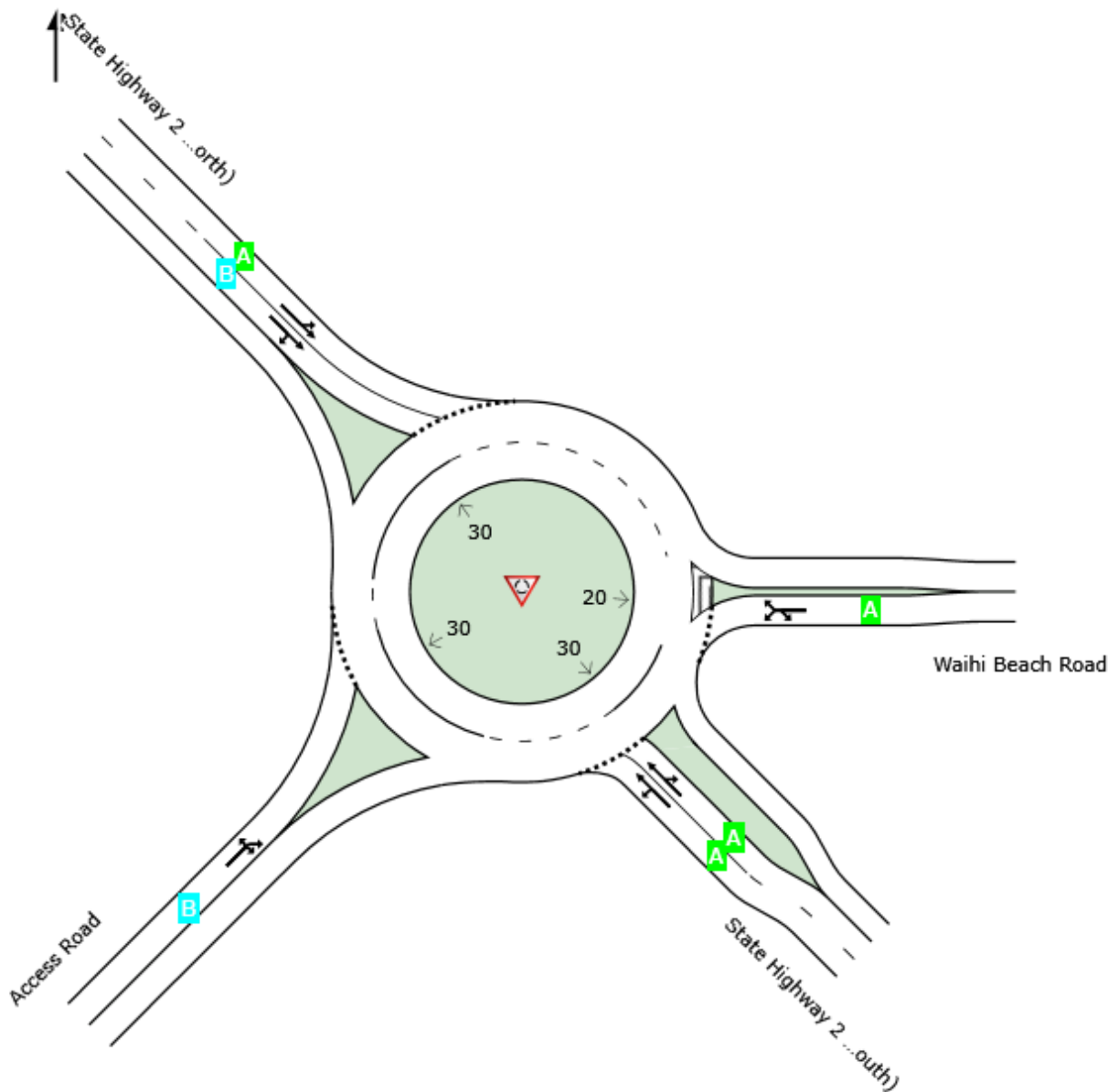
Lane Level of Service

 Site: 101vvvv [SH2_Waihi_PM_2020+HD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	A	A	A	B	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_AM_2028+LD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	54.3	54.3 km/h
Travel Distance (Total)	veh-km/h	1868.9	2242.7 pers-km/h
Travel Time (Total)	veh-h/h	34.4	41.3 pers-h/h
Desired Speed	km/h	68.9	
Speed Efficiency		0.79	
Travel Time Index		7.64	
Congestion Coefficient		1.27	
Demand Flows (Total)	veh/h	1792	2150 pers/h
Arrival Flows (Total)	veh/h	1792	
Percent Heavy Vehicles (Demand)	%	10.8	
Percent Heavy Vehicles (Arrivals)	%	10.8	
Degree of Saturation		0.678	
Practical Spare Capacity	%	25.3	
Effective Intersection Capacity	veh/h	2642	
Control Delay (Total)	veh-h/h	4.86	5.84 pers-h/h
Control Delay (Average)	sec	9.8	9.8 sec
Control Delay (Worst Lane by MC)	sec	13.1	
Control Delay (Worst Movement by MC)	sec	16.0	16.0 sec
Geometric Delay (Average)	sec	6.4	
Stop-Line Delay (Average)	sec	3.4	
Idling Time (Average)	sec	0.2	
Intersection Level of Service (LOS)		LOS A	
95% Back of Queue - Veh (Worst Lane)	veh	7.6	
95% Back of Queue - Dist (Worst Lane)	m	59.7	
Ave. Que Storage Ratio (Worst Lane)		0.05	
Effective Stops (Total)	veh/h	1183	1419 pers/h
Effective Stop Rate		0.66	0.66
Proportion Queued		0.68	0.68
Performance Index		64.6	64.6
Cost (Total)	\$/h	1671.61	1671.61 \$/h
Fuel Consumption (Total)	L/h	286.8	
Carbon Dioxide (Total)	kg/h	689.6	
Hydrocarbons (Total)	kg/h	0.063	
Carbon Monoxide (Total)	kg/h	0.93	
NOx (Total)	kg/h	2.253	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 3.8 %

Number of Iterations: 7 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.0% 1.6% 0.9%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	859,958	1,031,950 pers/y
Delay (Total)	veh-h/y	2,335	2,802 pers-h/y

Effective Stops (Total)	veh/y	567,791	681,349 pers/y
Travel Distance (Total)	veh-km/y	897,088	1,076,506 pers-km/y
Travel Time (Total)	veh-h/y	16,518	19,822 pers-h/y
Cost (Total)	\$/y	802,374	802,374 \$/y
Fuel Consumption (Total)	L/y	137,678	
Carbon Dioxide (Total)	kg/y	331,006	
Hydrocarbons (Total)	kg/y	30	
Carbon Monoxide (Total)	kg/y	449	
NOx (Total)	kg/y	1,081	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

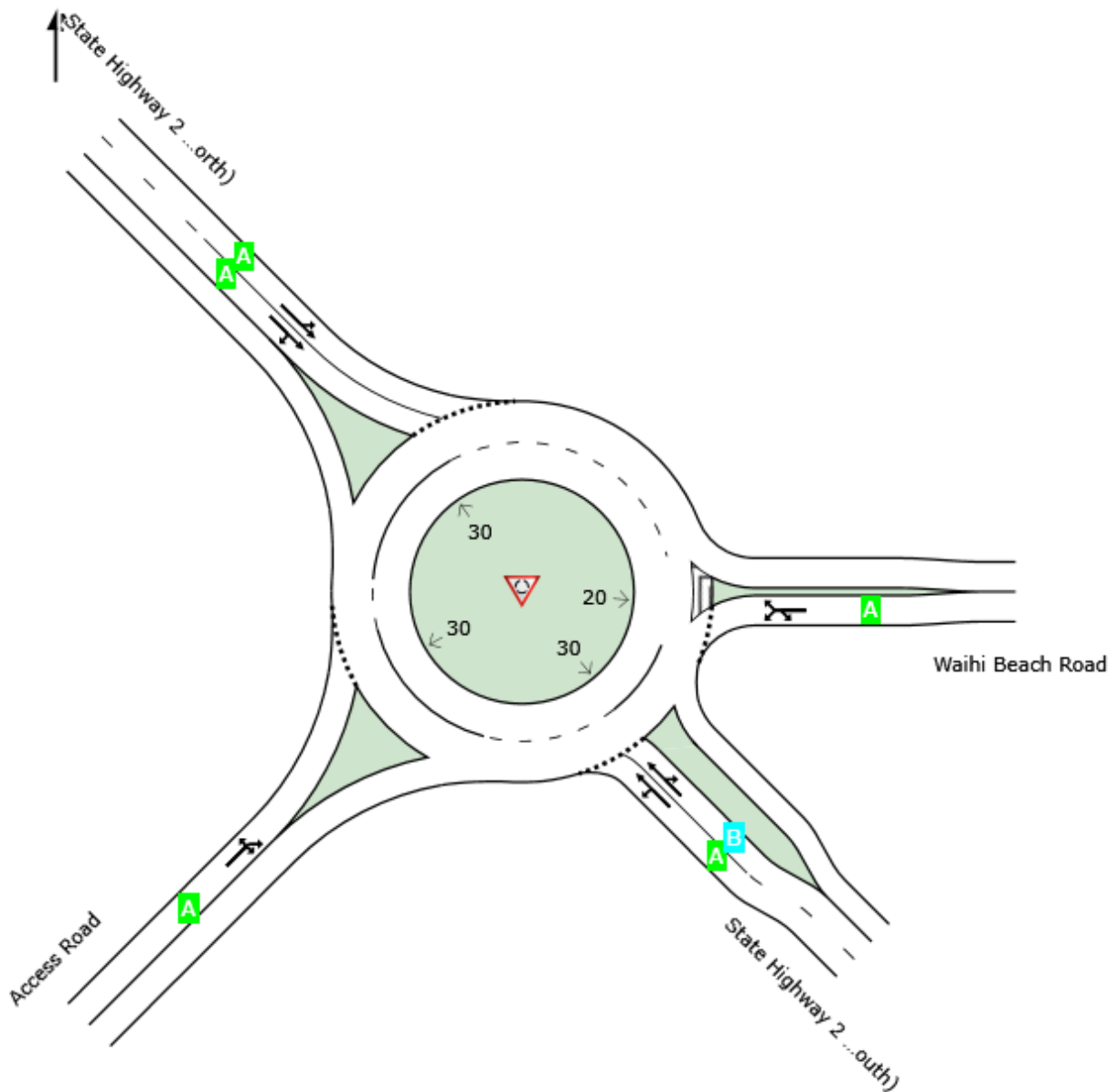
Lane Level of Service

 Site: 101vvvv [SH2_Waihi_AM_2028+LD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_PM_2028+LD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	54.4	54.4 km/h
Travel Distance (Total)	veh-km/h	1876.7	2252.0 pers-km/h
Travel Time (Total)	veh-h/h	34.5	41.4 pers-h/h
Desired Speed	km/h	68.9	
Speed Efficiency		0.79	
Travel Time Index		7.66	
Congestion Coefficient		1.27	
Demand Flows (Total)	veh/h	1792	2150 pers/h
Arrival Flows (Total)	veh/h	1792	
Percent Heavy Vehicles (Demand)	%	11.2	
Percent Heavy Vehicles (Arrivals)	%	11.2	
Degree of Saturation		0.567	
Practical Spare Capacity	%	49.8	
Effective Intersection Capacity	veh/h	3158	
Control Delay (Total)	veh-h/h	4.52	5.43 pers-h/h
Control Delay (Average)	sec	9.1	9.1 sec
Control Delay (Worst Lane by MC)	sec	11.2	
Control Delay (Worst Movement by MC)	sec	16.9	16.9 sec
Geometric Delay (Average)	sec	6.7	
Stop-Line Delay (Average)	sec	2.4	
Idling Time (Average)	sec	0.2	
Intersection Level of Service (LOS)		LOS A	
95% Back of Queue - Veh (Worst Lane)	veh	5.0	
95% Back of Queue - Dist (Worst Lane)	m	39.0	
Ave. Que Storage Ratio (Worst Lane)		0.03	
Effective Stops (Total)	veh/h	1115	1338 pers/h
Effective Stop Rate		0.62	0.62
Proportion Queued		0.59	0.59
Performance Index		59.5	59.5
Cost (Total)	\$/h	1680.72	1680.72 \$/h
Fuel Consumption (Total)	L/h	289.0	
Carbon Dioxide (Total)	kg/h	695.1	
Hydrocarbons (Total)	kg/h	0.063	
Carbon Monoxide (Total)	kg/h	0.94	
NOx (Total)	kg/h	2.287	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 2.7 %

Number of Iterations: 7 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.0% 1.1% 0.6%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	859,958	1,031,950 pers/y
Delay (Total)	veh-h/y	2,170	2,604 pers-h/y

Effective Stops (Total)	veh/y	535,347	642,416 pers/y
Travel Distance (Total)	veh-km/y	900,815	1,080,978 pers-km/y
Travel Time (Total)	veh-h/y	16,568	19,882 pers-h/y
Cost (Total)	\$/y	806,746	806,746 \$/y
Fuel Consumption (Total)	L/y	138,712	
Carbon Dioxide (Total)	kg/y	333,666	
Hydrocarbons (Total)	kg/y	30	
Carbon Monoxide (Total)	kg/y	450	
NOx (Total)	kg/y	1,098	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

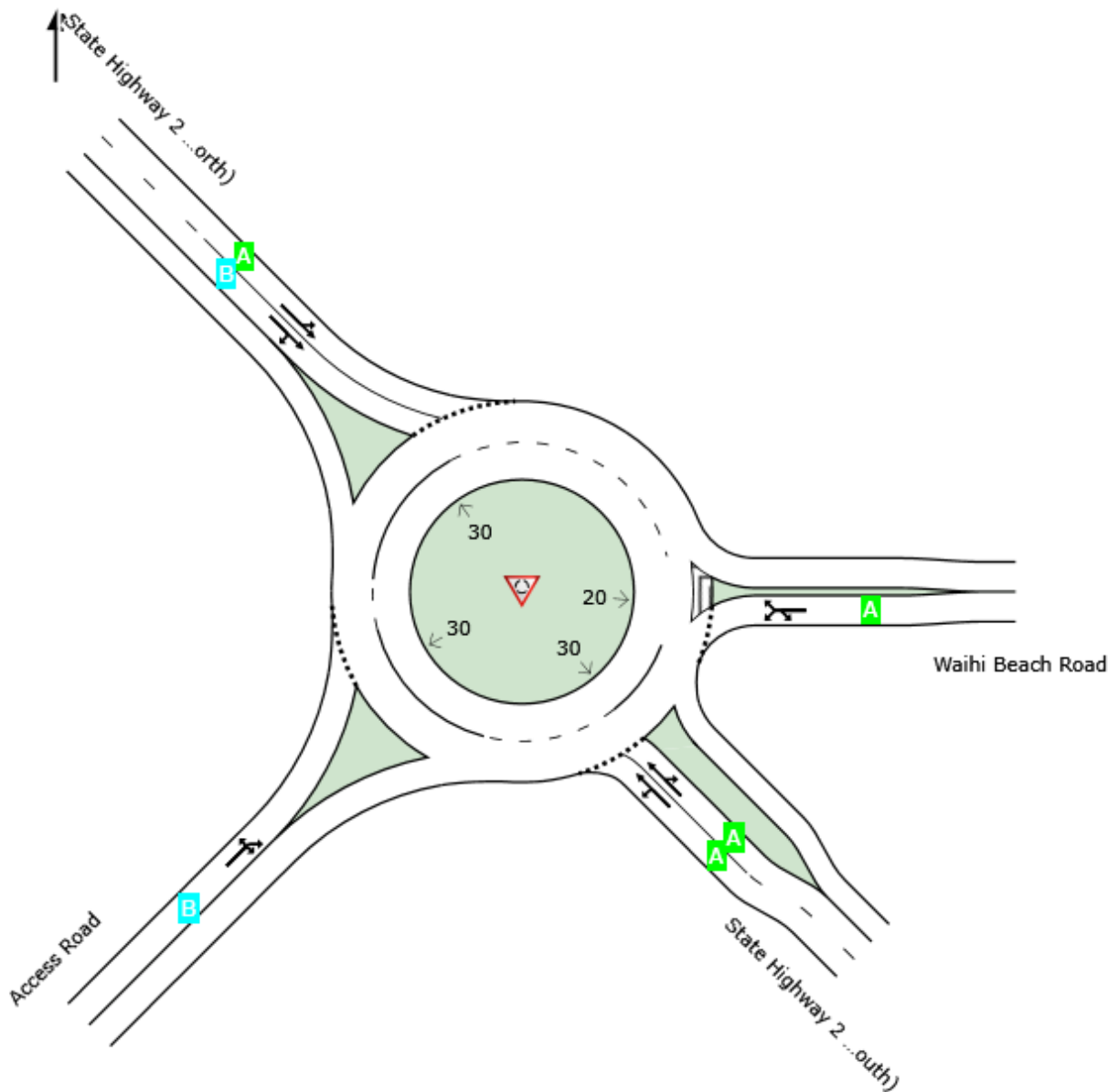
Lane Level of Service

 Site: 101vvvv [SH2_Waihi_PM_2028+LD (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	A	A	A	B	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

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INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_AM_2043 (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	54.4	54.4 km/h
Travel Distance (Total)	veh-km/h	2209.9	2651.9 pers-km/h
Travel Time (Total)	veh-h/h	40.6	48.7 pers-h/h
Desired Speed	km/h	72.7	
Speed Efficiency		0.75	
Travel Time Index		7.20	
Congestion Coefficient		1.34	
Demand Flows (Total)	veh/h	2118	2541 pers/h
Arrival Flows (Total)	veh/h	2118	
Percent Heavy Vehicles (Demand)	%	11.0	
Percent Heavy Vehicles (Arrivals)	%	11.0	
Degree of Saturation		0.842	
Practical Spare Capacity	%	1.0	
Effective Intersection Capacity	veh/h	2517	
Control Delay (Total)	veh-h/h	7.22	8.66 pers-h/h
Control Delay (Average)	sec	12.3	12.3 sec
Control Delay (Worst Lane by MC)	sec	17.2	
Control Delay (Worst Movement by MC)	sec	20.6	20.6 sec
Geometric Delay (Average)	sec	6.7	
Stop-Line Delay (Average)	sec	5.6	
Idling Time (Average)	sec	0.4	
Intersection Level of Service (LOS)		LOS B	
95% Back of Queue - Veh (Worst Lane)	veh	15.1	
95% Back of Queue - Dist (Worst Lane)	m	118.6	
Ave. Queue Storage Ratio (Worst Lane)		0.10	
Effective Stops (Total)	veh/h	1583	1900 pers/h
Effective Stop Rate		0.75	0.75
Proportion Queued		0.78	0.78
Performance Index		88.8	88.8
Cost (Total)	\$/h	2039.82	2039.82 \$/h
Fuel Consumption (Total)	L/h	359.7	
Carbon Dioxide (Total)	kg/h	864.8	
Hydrocarbons (Total)	kg/h	0.080	
Carbon Monoxide (Total)	kg/h	1.20	
NOx (Total)	kg/h	2.878	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 5.7 %

Number of Iterations: 8 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 3.2% 1.7% 0.8%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	1,016,590	1,219,908 pers/y
Delay (Total)	veh-h/y	3,464	4,157 pers-h/y
Effective Stops (Total)	veh/y	759,907	911,888 pers/y

Travel Distance (Total)	veh-km/y	1,060,774	1,272,929 pers-km/y
Travel Time (Total)	veh-h/y	19,498	23,397 pers-h/y
Cost (Total)	\$/y	979,112	979,112 \$/y
Fuel Consumption (Total)	L/y	172,674	
Carbon Dioxide (Total)	kg/y	415,109	
Hydrocarbons (Total)	kg/y	39	
Carbon Monoxide (Total)	kg/y	578	
NOx (Total)	kg/y	1,381	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

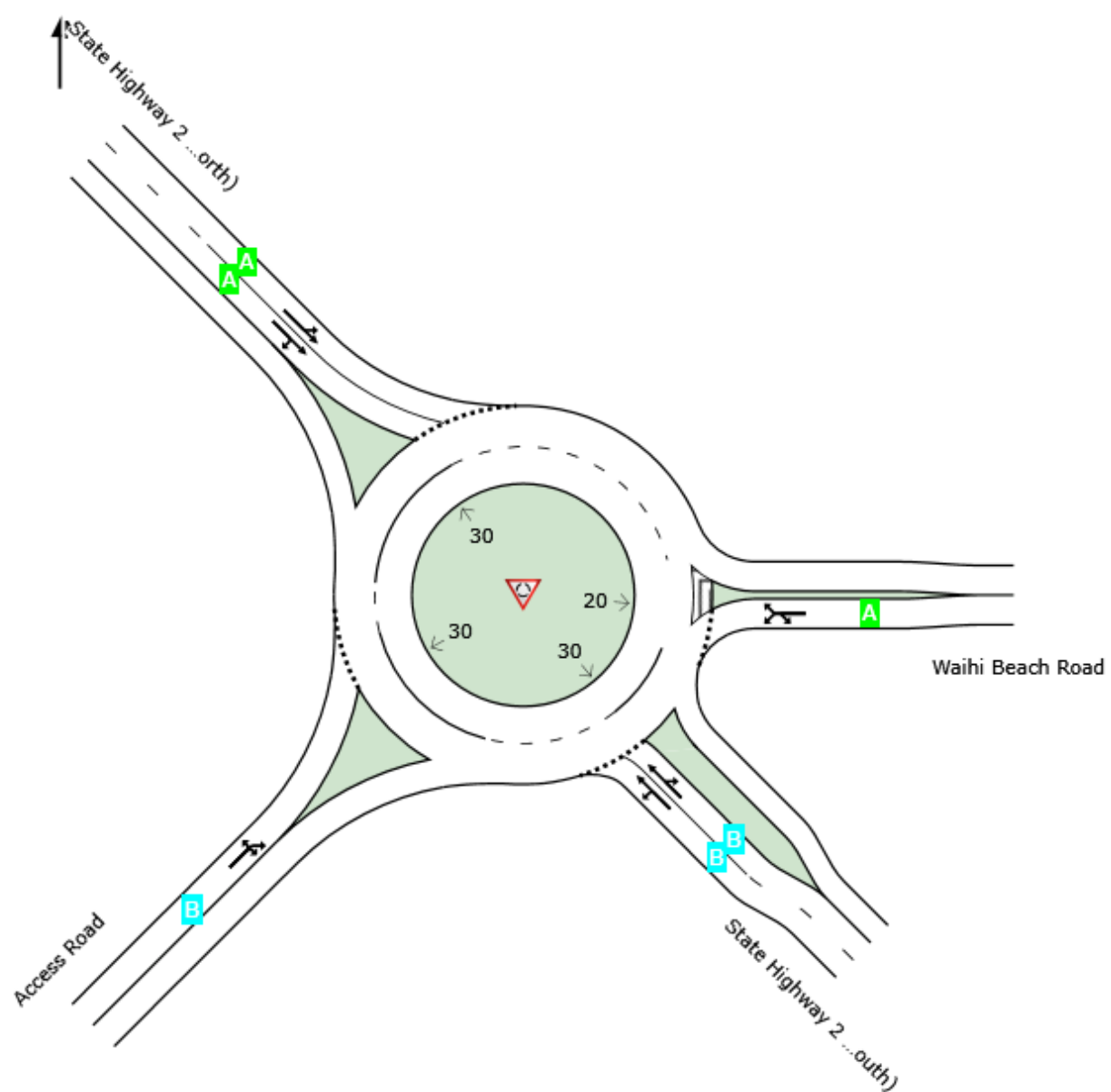
Lane Level of Service

 **Site: 101vvvv [SH2_Waihi_AM_2043 (Site Folder: General)]**

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	B	B



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

INTERSECTION SUMMARY

 Site: 101vvvv [SH2_Waihi_PM_2043 (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

NA

Site Category: (None)

Roundabout

Intersection Performance - Hourly Values			
Performance Measure	Vehicles:	All MCs	Persons
Travel Speed (Average)	km/h	55.6	55.6 km/h
Travel Distance (Total)	veh-km/h	2218.8	2662.6 pers-km/h
Travel Time (Total)	veh-h/h	39.9	47.9 pers-h/h
Desired Speed	km/h	72.7	
Speed Efficiency		0.77	
Travel Time Index		7.39	
Congestion Coefficient		1.31	
Demand Flows (Total)	veh/h	2118	2541 pers/h
Arrival Flows (Total)	veh/h	2118	
Percent Heavy Vehicles (Demand)	%	12.0	
Percent Heavy Vehicles (Arrivals)	%	12.0	
Degree of Saturation		0.753	
Practical Spare Capacity	%	12.9	
Effective Intersection Capacity	veh/h	2814	
Control Delay (Total)	veh-h/h	5.64	6.77 pers-h/h
Control Delay (Average)	sec	9.6	9.6 sec
Control Delay (Worst Lane by MC)	sec	13.2	
Control Delay (Worst Movement by MC)	sec	19.2	19.2 sec
Geometric Delay (Average)	sec	6.9	
Stop-Line Delay (Average)	sec	2.7	
Idling Time (Average)	sec	0.3	
Intersection Level of Service (LOS)		LOS A	
95% Back of Queue - Veh (Worst Lane)	veh	9.4	
95% Back of Queue - Dist (Worst Lane)	m	73.6	
Ave. Queue Storage Ratio (Worst Lane)		0.06	
Effective Stops (Total)	veh/h	1320	1584 pers/h
Effective Stop Rate		0.62	0.62
Proportion Queued		0.69	0.69
Performance Index		72.9	72.9
Cost (Total)	\$/h	2034.13	2034.13 \$/h
Fuel Consumption (Total)	L/h	363.1	
Carbon Dioxide (Total)	kg/h	873.9	
Hydrocarbons (Total)	kg/h	0.081	
Carbon Monoxide (Total)	kg/h	1.21	
NOx (Total)	kg/h	2.978	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Intersection LOS value for Vehicles is based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.

In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 4.7 %

Number of Iterations: 8 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.5% 1.3% 0.7%

Intersection Performance - Annual Values			
Performance Measure	Vehicles:	All MCs	Persons
Demand Flows (Total)	veh/y	1,016,590	1,219,908 pers/y
Delay (Total)	veh-h/y	2,707	3,249 pers-h/y
Effective Stops (Total)	veh/y	633,553	760,264 pers/y

Travel Distance (Total)	veh-km/y	1,065,037	1,278,044 pers-km/y
Travel Time (Total)	veh-h/y	19,150	22,980 pers-h/y
Cost (Total)	\$/y	976,381	976,381 \$/y
Fuel Consumption (Total)	L/y	174,273	
Carbon Dioxide (Total)	kg/y	419,478	
Hydrocarbons (Total)	kg/y	39	
Carbon Monoxide (Total)	kg/y	583	
NOx (Total)	kg/y	1,429	

1 Hours per Year: 480 (Site)

LANE LEVEL OF SERVICE

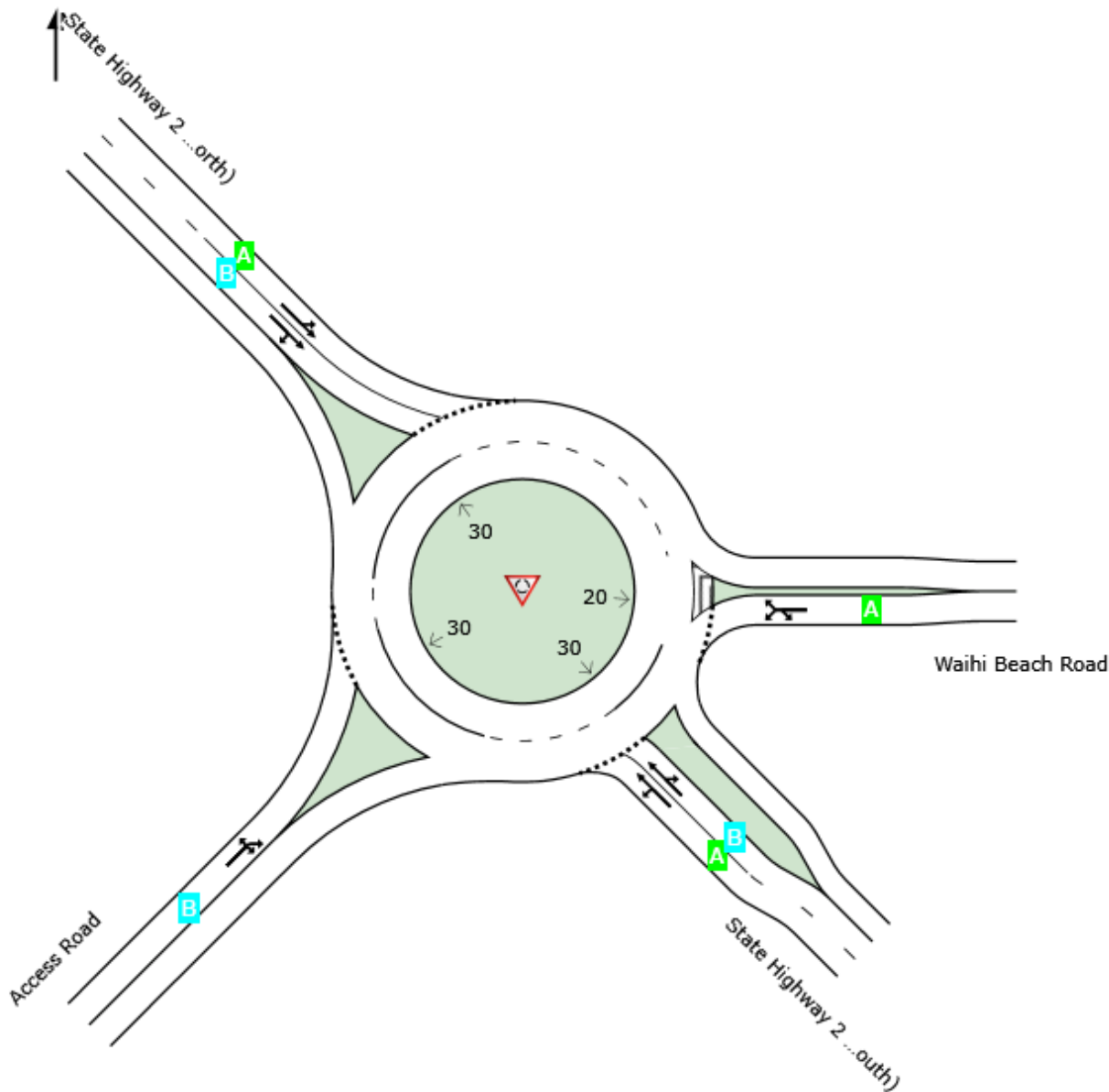
Lane Level of Service

 Site: 101vvvv [SH2_Waihi_PM_2043 (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

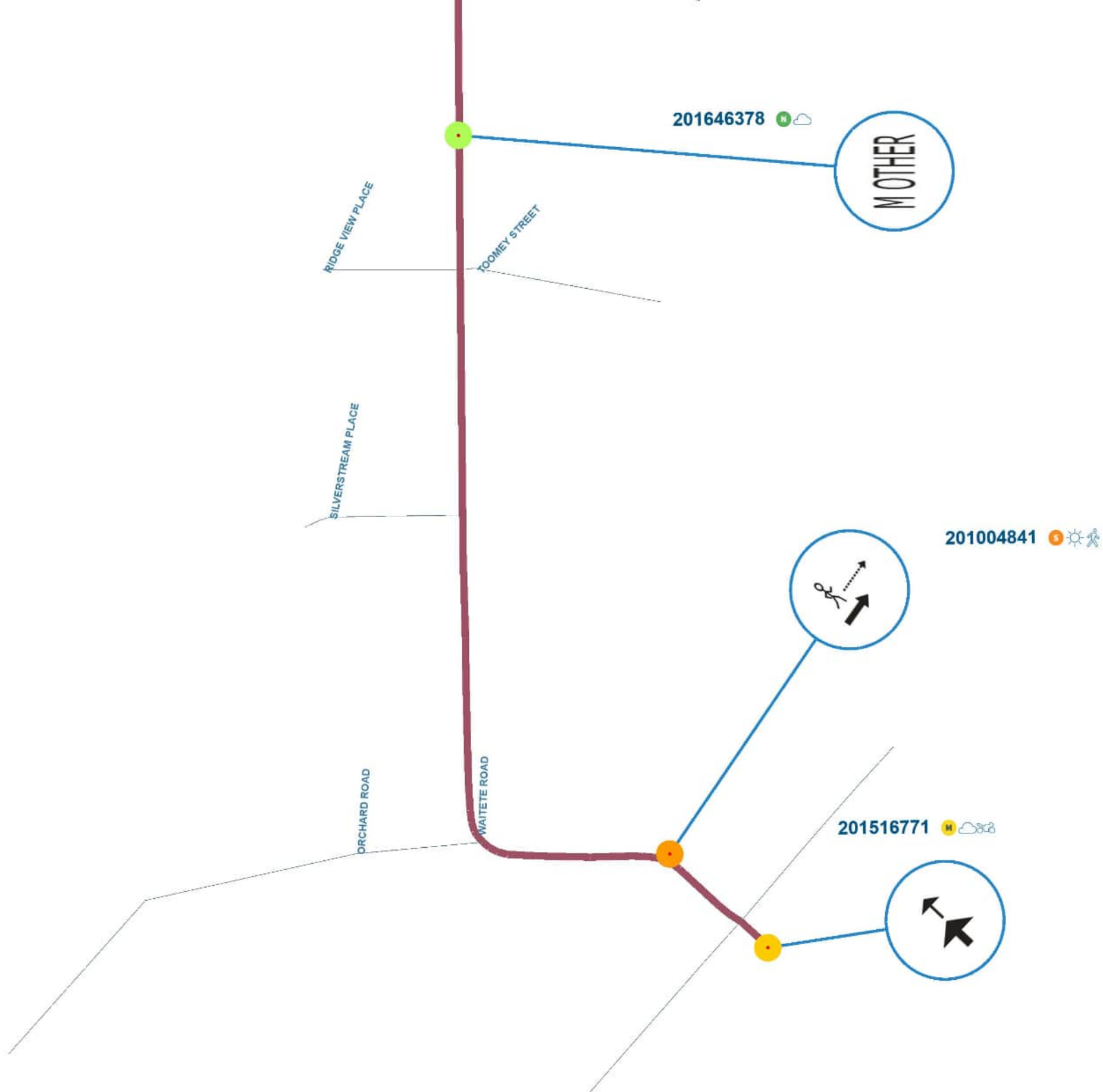
NA
Site Category: (None)
Roundabout

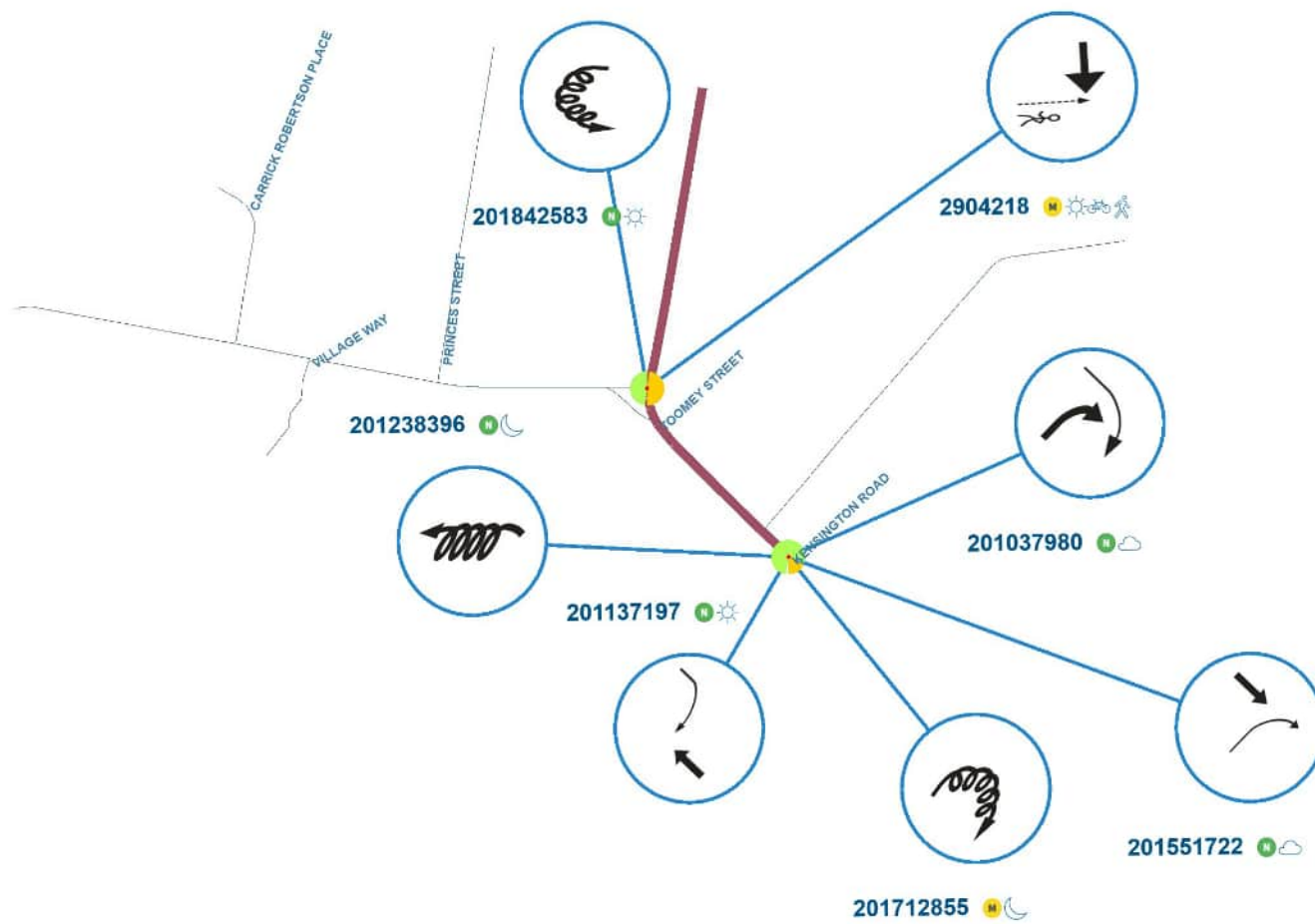
	Approaches				Intersection
	Southeast	East	Northwest	Southwest	
LOS	B	A	A	B	A

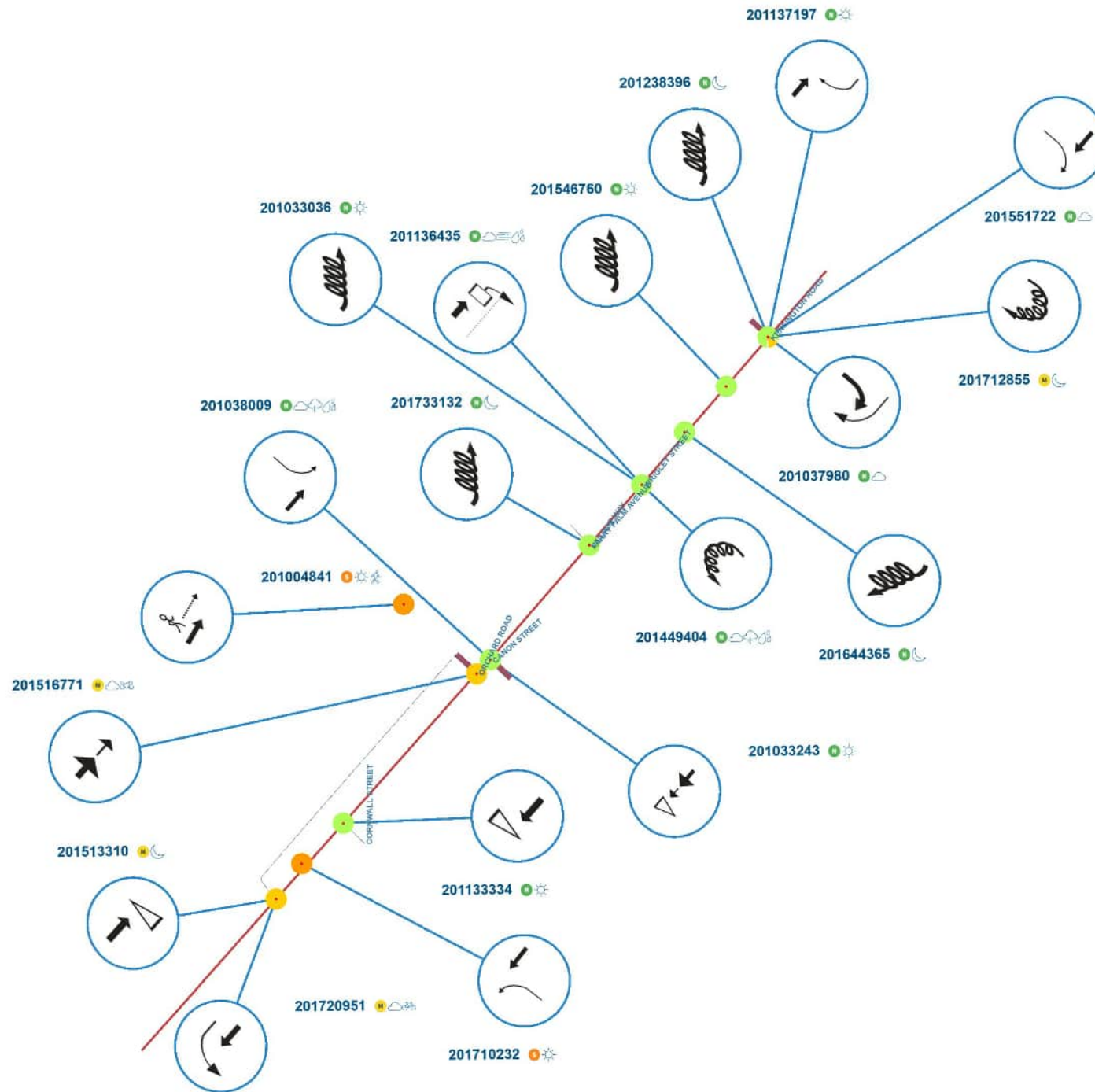


Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Appendix D W4 CAS Outputs







Untitled query

Saved sites

[Waihi W4](#)

Crash year

[2009](#) — [2019](#)

Plain English report

22 results from your query.

Showing [20](#) results at once.

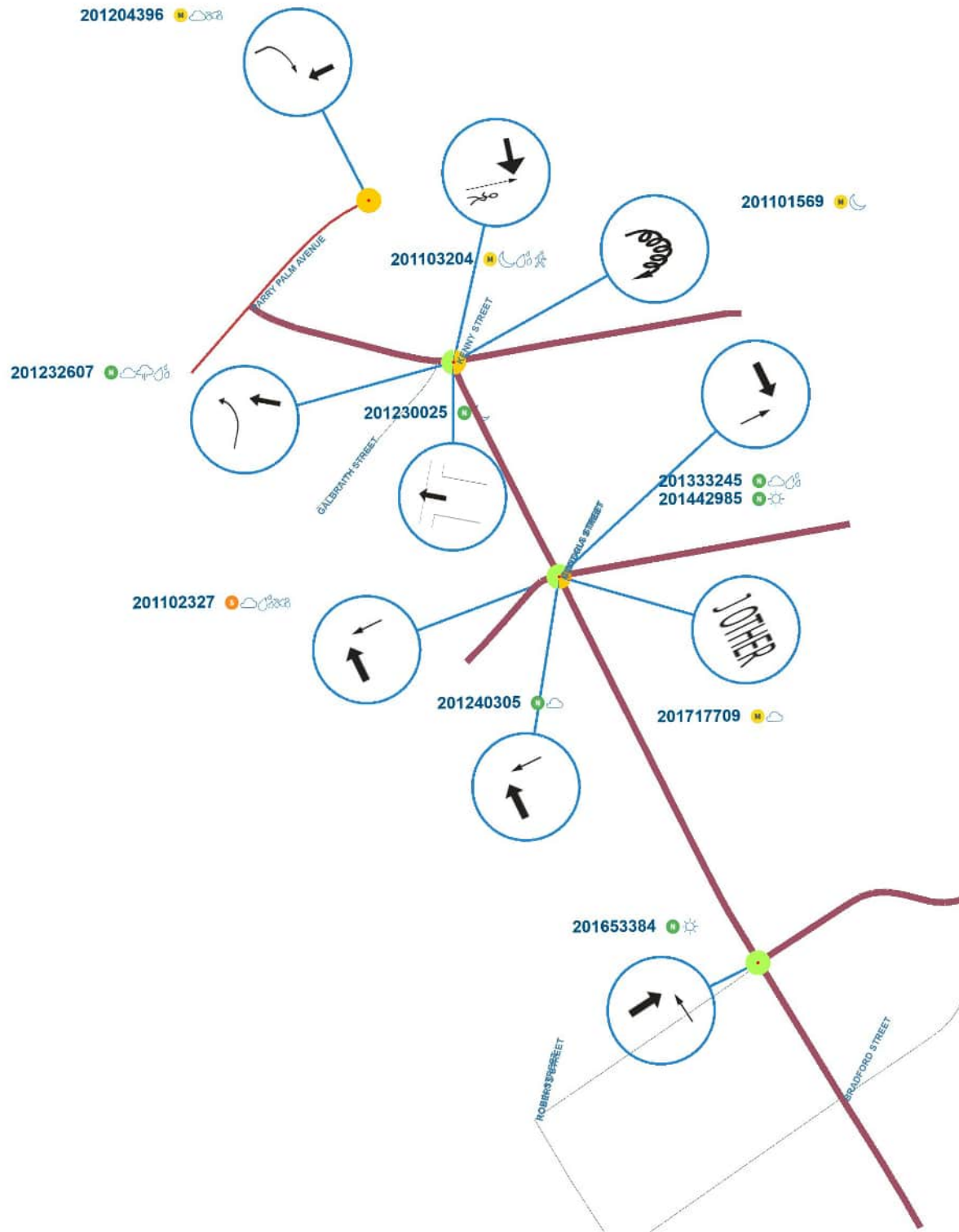
1-22 of 22

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
KENSINGTON ROAD		I	TOOMEY ST	201842583	06/05/2018	Sun	08:30	Car/Wagon1 SDB on KENSINGTON ROAD lost control turning left, Car/Wagon1 hit non specific fence	CAR/WAGON1, lost control when turning, speed entering corner/curve	Dry	Bright sun	Fine	T Junction	Nil	0	0	0
KENSINGTON ROAD		I	TOOMEY ST	2904218	06/08/2009	Thu	08:30	Cycle1 SDB on KENSINGTON ROAD hit PEDESTRIAN crossing road from right side	PEDESTRIAN2, stepping out from behind vehicle, ENV: entering or leaving other commercial	Dry	Bright sun	Fine	Driveway	Nil	0	0	2
ORCHARD ROAD	80m	N	SH 2	201004841	19/08/2010	Thu	07:31	Van1 EDB on ORCHARD ROAD hit Pedestrian2 (Age 66) walking with traffic	VAN1, driver dazzled, PEDESTRIAN2, pedestrian not facing oncoming traffic, ENV: dazzling sun	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	1	0
SH 2		I	CANON ST	201033243	12/04/2010	Mon	13:10	Car/Wagon1 WDB on SH 2 hit rear end of Car/Wagon2 stop/slow for obstruction	CAR/WAGON2, travelling unreasonably slowly	Dry	Bright sun	Fine	T Junction	Give way	0	0	0
SH 2		I	CANON ST	201038009	01/08/2010	Sun	14:52	SUV1 NDB on SH 2 hit Car/Wagon2 merging from the left	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control, ENV: heavy rain	Wet	Overcast	Heavy rain	T Junction	Give way	0	0	0
SH 2	50m	N	CORNWALL ST	201133334	03/01/2011	Mon	13:00	Car/Wagon1 SDB on SH 2 hit obstruction, Car/Wagon1 hit non specific animal	ENV: household pet rushed out or playing	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	0
SH 2		I	CORNWALL ST	201710232	14/01/2017	Sat	11:53	Car/Wagon1 SDB on Sh2 hit Moped2 merging from the left	CAR/WAGON1, swerved to avoid vehicle MOPED2, alcohol suspected, failed to give way at priority traffic control	Dry	Bright sun	Fine	T Junction	Give way	0	1	0
SH 2	1000m	W	MORESBY AVENUE	201449404	14/12/2014	Sun	14:30	Car/Wagon1 SDB on SH 2 lost control turning left, Car/Wagon1 hit non specific cliff	CAR/WAGON1, lost control when turning, ENV: heavy rain, slippery road due to rain	Wet	Overcast	Heavy rain	Nil (Default)	Unknown	0	0	0

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	Description of events	Crash factors	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
SH 2	60m	S	ORCHARD ROAD	201516771	14/09/2015	Mon	10:50	Car/Wagon1 NDB on SH 2 hit rear end of Motorcycle2 stopped/moving slowly	CAR/WAGON1, attention diverted by food, cigarettes, beverages	Dry	Overcast	Fine	Nil (Default)	Nil	0	0	1
SH 2	1500m	N	SAMSON ROAD	201513310	13/05/2015	Wed	02:44	Car/Wagon1 NDB on SH 2 hit obstruction, Car/Wagon1 hit non specific animal	ENV: farm animal straying	Dry	Dark	Fine	Nil (Default)	Nil	0	0	2
SH 2		I	SLIP ROAD	201720951	15/03/2017	Wed	16:35	Car/Wagon1 WDB on State highway 2 sideswiped by Cyclist2 (Age 69) WDB on State highway 2 turning left	CAR/WAGON1, alcohol test below limit	Dry	Overcast	Fine	T Junction	Nil	0	0	2
SH 2		I	TOOMEY ST	201712855	07/04/2017	Fri	22:40	Car/Wagon1 SDB on Toomey Street, Waihi, Hauraki lost control turning right, Car/Wagon1 hit non specific building	CAR/WAGON1, alcohol suspected, speed entering corner/curve	Dry	Dark	Fine	Crossroads	Give way	0	0	1
SH 2		I	TOOMEY ST	201137197	21/08/2011	Sun	16:20	Car/Wagon2 turning right hit by oncoming Car/Wagon1 NDB on SH 2	CAR/WAGON2, failed to give way turning to non-turning traffic, impaired ability due to old age	Dry	Bright sun	Fine	Crossroads	Give way	0	0	0
SH 2	100m	S	TOOMEY ST	201644365	03/07/2016	Sun	20:50	Car/Wagon1 SDB on SH 2 lost control; went off road to right, Car/Wagon1 hit non specific tree	CAR/WAGON1, attention diverted by food, cigarettes, beverages	Dry	Dark	Fine	Nil (Default)	Unknown	0	0	0
SH 2	50m	S	TOOMEY ST	201546760	05/06/2015	Fri	13:27	Van1 NDB on SH 2 lost control; went off road to left, Van1 hit non specific parked	VAN1, other lost control, sudden illness	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	0
SH 2	10m	N	TOOMEY ST	201238396	03/09/2012	Mon	01:11	Car/Wagon1 NDB on SH 2 lost control; went off road to left, Car/Wagon1 hit non specific pole	CAR/WAGON1, other fatigue	Dry	Dark	Fine	T Junction	Give way	0	0	0
SH 2		I	TOOMEY ST	201551722	27/11/2015	Fri	08:20	Car/Wagon1 SDB on SH 2 hit Car/Wagon2 merging from the right	CAR/WAGON2, failed to give way turning to non-turning traffic, other fatigue	Dry	Overcast	Fine	T Junction	Nil	0	0	0
SH 2		I	TOOMEY ST	201037980	12/07/2010	Mon	13:50	Car/Wagon1 SDB on SH 2 turning right hit Car/Wagon2 turning right into AXROAD	CAR/WAGON1, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Overcast	Fine	Crossroads	Give way	0	0	0
SH 2		I	VILLAGE WAY	201733132	24/02/2017	Fri	03:55	Car/Wagon1 NDB on Parry Palm Ave lost control; went off road to left, Car/Wagon1 hit non specific pole	CAR/WAGON1, attn diverted by console inbuilt features radio/ac, driver unfamiliar with vehicle/towing	Dry	Dark	Fine	T Junction	Nil	0	0	0
SH 2	20m	N	WRIGLEY ST	201033036	16/03/2010	Tue	16:25	Car/Wagon1 NDB on SH 2 lost control; went off road to left, Car/Wagon1 hit non specific fence, non specific other	CAR/WAGON1, alcohol test above limit or test refused, other lost control, wheelspins/wheelies/doughnuts/driftng	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	0
SH 2		I	WRIGLEY ST	201136435	20/07/2011	Wed	14:45	Car/Wagon1 NDB on SH 2 hit rear of Car/Wagon2 NDB on SH 2 turning right from centre line	CAR/WAGON1, failed to notice indication of vehicle in front, other attention diverted, ENV: fog or mist	Wet	Overcast	Mist or Fog	T Junction	Give way	0	0	0

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	Description of events	Crash factors	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
WAITETE ROAD	80m	N	RIDGE VIEW PLACE	201646378	23/08/2016	Tue	16:30	Car/Wagon1 WDB on Waitete road, waihi hit Car/Wagon2 manoeuvring, Car/Wagon1 hit non specific parked	CAR/WAGON1, did not check/notice another party behind	Dry	Overcast	Fine	Driveway	Nil	0	0	0

Appendix E W6/W7 CAS Outputs



Untitled query

Saved sites

[Waihi W6](#)

Crash year

[2009 — 2019](#)

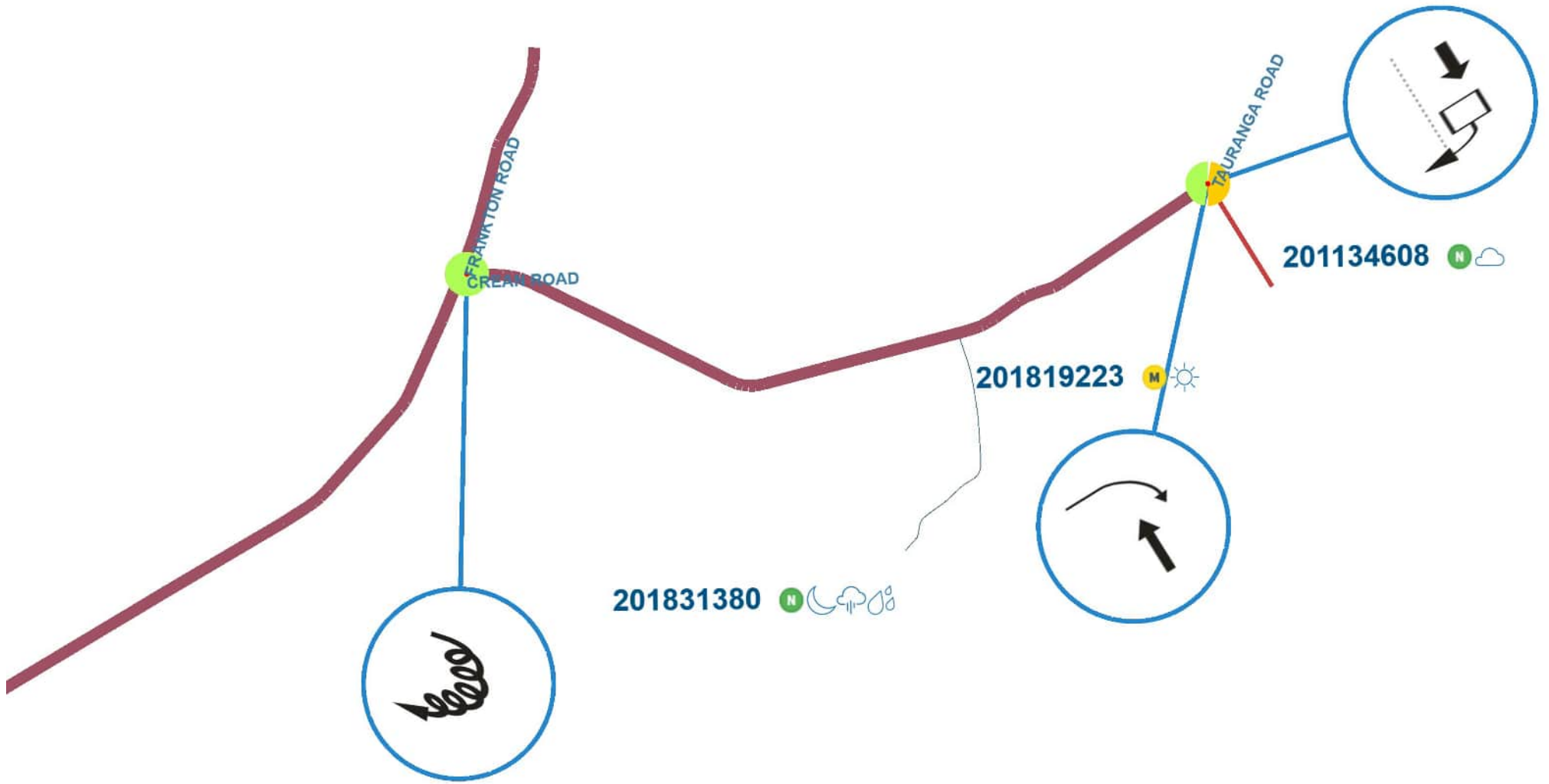
Plain English report

11 results from your query.

1-11 of 11

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
KENNY ST		I	VICTORIA ST	201230025	05/01/2012	Thu	22:01	Car/Wagon1 NDB on KENNY ST missed intersection or end of road, Car/Wagon1 hit non specific fence, non specific tree	CAR/WAGON1, lost control under braking, speed on straight	Dry	Dark	Fine	Multileg	Give way	0	0	0
KENNY ST		I	VICTORIA ST	201232607	14/05/2012	Mon	13:35	Car/Wagon1 WDB on KENNY ST hit Car/Wagon2 merging from the left	CAR/WAGON2, failed to give way at priority traffic control, ENV: slippery road due to rain	Wet	Overcast	Light rain	Multileg	Give way	0	0	0
ROBERTS ST		I	VICTORIA ST	201653384	24/11/2016	Thu	10:40	Car/Wagon1 NDB on Victoria Street hit Car/Wagon2 crossing at right angle from right	CAR/WAGON1, failed to give way at priority traffic control	Dry	Bright sun	Fine	Crossroads	Give way	0	0	0
SH 2 SEDDON		I	VICTORIA ST	201204396	01/10/2012	Mon	16:08	Car/Wagon2 turning right hit by oncoming Motorcycle1 WDB on SH 2 SEDDON	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way turning to non-turning traffic	Dry	Overcast	Fine	T Junction	Nil	0	0	1
VICTORIA ST		I	CONSOLS ST	201102327	22/04/2011	Fri	13:53	Car/Wagon1 WDB on VICTORIA ST hit Motorcycle2 crossing at right angle from right	CAR/WAGON1, did not check/notice another party from other dirn, failed to give way at priority traffic control	Wet	Overcast	Null	Crossroads	Give way	0	1	0
VICTORIA ST		I	CONSOLS ST	201240305	11/11/2012	Sun	16:10	Car/Wagon1 NDB on VICTORIA ST hit Car/Wagon2 crossing at right angle from right	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Overcast	Fine	Crossroads	Give way	0	0	0
VICTORIA ST		I	CONSOLS ST	201333245	28/05/2013	Tue	12:55	Car/Wagon1 SDB on VICTORIA ST hit Car/Wagon2 crossing at right angle from right	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control	Wet	Overcast	Null	Crossroads	Give way	0	0	0

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	<u>Description of events</u>	<u>Crash factors</u>	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
VICTORIA ST		I	CONSOLS ST	201717709	20/09/2017	Wed	14:15	Truck1 SDB on Victoria St hit turning Car/Wagon2 , Car/Wagon2 hit non specific pole	CAR/WAGON2, did not check/notice another party from other dirn, failed to give way at priority traffic control, other attention diverted	Dry	Overcast	Fine	Crossroads	Give way	0	0	1
VICTORIA ST		I	CONSOLS ST	201442985	16/08/2014	Sat	11:29	Car/Wagon1 SDB on VICTORIA ST hit Car/Wagon2 crossing at right angle from right	CAR/WAGON2, attention diverted by other traffic, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Bright sun	Fine	Crossroads	Give way	0	0	0
VICTORIA ST		I	KENNY ST	201101569	13/03/2011	Sun	00:54	Car/Wagon1 EDB on VICTORIA ST lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, alcohol test above limit or test refused, driver unfamiliar with vehicle/towing, lost control when turning	Dry	Dark	Fine	Multileg	Give way	0	0	1
VICTORIA ST	15m	S	KENNY ST	201103204	19/06/2011	Sun	18:10	SUV1 SDB on VICTORIA ST hit Pedestrian2 (Age 16) crossing road from right side	PEDESTRIAN2, failed to see another party wearing dark clothing, pedestrian walking across heedless of traffic, ENV: other slippery road	Wet	Dark	Fine	Nil (Default)	Unknown	0	0	1



Untitled query

Saved sites

W6

Crash year

2009 — 2019

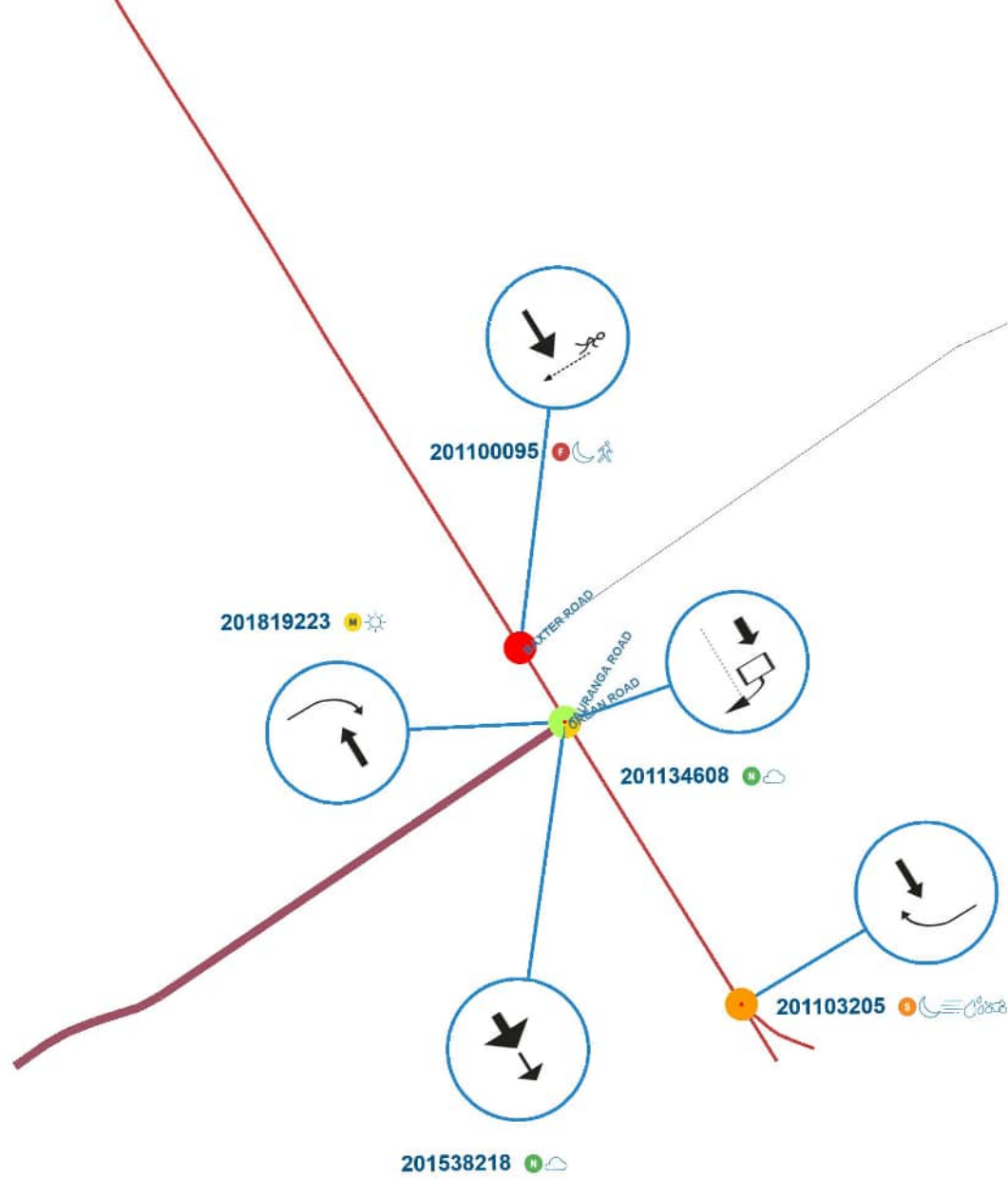
Plain English report

4 results from your query.

1-4 of 4

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	<u>Description of events</u>	<u>Crash factors</u>	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
FRANKTON ROAD		I	CREAN ROAD	201831380	01/01/2018	Mon	02:35	Car/Wagon1 WDB on Frankton lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, lost control when turning	Wet	Dark	Light rain	T Junction	Give way	0	0	0
FRANKTON ROAD	290m	N	CREAN ROAD	201740027	26/05/2017	Fri	21:30	Car/Wagon1 NDB on Frankton lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, inappropriate speed for road conditions, new driver/under instruction, ENV: slippery road due to rain	Wet	Dark	Light rain	Nil (Default)	Unknown	0	0	0
SH 2		I	CREAN ROAD	201819223	24/10/2018	Wed	08:30	Van1 NDB on SH2 hit SUV2 turning right onto AXROAD from the left	VAN1, alcohol test below limit SUV2, alcohol test below limit, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Bright sun	Fine	T Junction	Give way	0	0	1
SH 2		I	CREAN ROAD	201134608	30/01/2011	Sun	10:58	SUV1 SDB on SH 2 hit rear of Car/Wagon2 SDB on SH 2 turning right from centre line	SUV1, lost control under acceleration	Dry	Overcast	Fine	T Junction	Give way	0	0	0

1-4 of 4



Untitled query

Saved sites

[W6](#)

Crash year

[2009 — 2019](#)

Plain English report

8 results from your query.

1-8 of 8

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
FRANKTON ROAD		I	CREAN ROAD	201831380	01/01/2018	Mon	02:35	Car/Wagon1 WDB on Frankton lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, lost control when turning	Wet	Dark	Light rain	T Junction	Give way	0	0	0
FRANKTON ROAD	290m	N	CREAN ROAD	201740027	26/05/2017	Fri	21:30	Car/Wagon1 NDB on Frankton lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, inappropriate speed for road conditions, new driver/under instruction, ENV: slippery road due to rain	Wet	Dark	Light rain	Nil (Default)	Unknown	0	0	0
SH 2		I	BAXTER ROAD	201100095	12/09/2011	Mon	19:30	Car/Wagon1 SDB on SH 2 hit Pedestrian2 (Age 53) crossing road from left side	CAR/WAGON1, did not check/notice another party from other dirn, PEDESTRIAN2, alcohol impaired non-driver (pedestrian/cyclist/pa, failed to see another party wearing dark clothing, pedestrian walking across heedless of traffic	Dry	Dark	Fine	T Junction	Nil	1	0	0
SH 2	200m	S	BAXTER ROAD	201538218	07/04/2015	Tue	14:50	Car/Wagon1 SDB on SH 2 hit rear end of Car/Wagon2 stopped/moving slowly	CAR/WAGON2, other vehicle controls CAR/WAGON1, failed to notice car slowing, stopping/stationary	Dry	Overcast	Fine	Nil (Default)	Unknown	0	0	0
SH 2		I	CREAN ROAD	201819223	24/10/2018	Wed	08:30	Van1 NDB on SH2 hit SUV2 turning right onto AXROAD from the left	VAN1, alcohol test below limit SUV2, alcohol test below limit, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Bright sun	Fine	T Junction	Give way	0	0	1
SH 2		I	CREAN ROAD	201134608	30/01/2011	Sun	10:58	SUV1 SDB on SH 2 hit rear of Car/Wagon2 SDB on SH 2 turning right from centre line	SUV1, lost control under acceleration	Dry	Overcast	Fine	T Junction	Give way	0	0	0

<u>Crash road</u>	<u>Distance</u>	<u>Direction</u>	<u>Side road</u>	<u>ID</u>	<u>Date</u>	<u>Day of week</u>	<u>Time</u>	Description of events	Crash factors	<u>Surface condition</u>	<u>Natural light</u>	<u>Weather</u>	<u>Junction</u>	<u>Control</u>	<u>Crash count fatal</u>	<u>Crash count severe</u>	<u>Crash count minor</u>
SH 2	120m	N	WAIHI BEACH ROAD	201103205	19/06/2011	Sun	19:58	SUV1 SDB on SH 2 hit Motorcycle2 turning right onto AXROAD from the left	MOTORCYCLE2, alcohol suspected, failed to give way entering roadway from driveway, ENV: entering or leaving private house / farm, fog or mist	Wet	Dark	Mist or Fog	Driveway	Unknown	0	1	0
VICTORIA ST	30m	N	SILVERTON ROAD	201137222	06/09/2011	Tue	15:15	Truck1 NDB on VICTORIA ST hit Car/Wagon2 U-turning from same direction of travel	CAR/WAGON2, did not check/notice another party behind	Dry	Overcast	Fine	Nil (Default)	Unknown	0	0	0

1-8 of 8

Appendix F W6/W7 Modelling Reports

Modelling outputs for the following intersections included:

- **Kenny, Victoria and Galbraith Streets**
- **State Highway 2 and Kenny Street**

INTERSECTION SUMMARY

Site: 101 [Kenny_Vic_Gal_AM_2019+LD (Site Folder: General)]

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

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	46.7 km/h	46.7 km/h
Travel Distance (Total)	538.8 veh-km/h	646.6 pers-km/h
Travel Time (Total)	11.5 veh-h/h	13.8 pers-h/h
Desired Speed (Program)	50.0 km/h	
Speed Efficiency	0.93	
Travel Time Index	9.27	
Congestion Coefficient	1.07	
Demand Flows (Total)	735 veh/h	882 pers/h
Percent Heavy Vehicles (Demand)	9.2 %	
Degree of Saturation	0.243	
Practical Spare Capacity	228.6 %	
Effective Intersection Capacity	3018 veh/h	
Control Delay (Total)	0.69 veh-h/h	0.83 pers-h/h
Control Delay (Average)	3.4 sec	3.4 sec
Control Delay (Worst Lane)	11.3 sec	
Control Delay (Worst Movement)	13.6 sec	13.6 sec
Geometric Delay (Average)	2.3 sec	
Stop-Line Delay (Average)	1.1 sec	
Idling Time (Average)	0.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	1.0 veh	
95% Back of Queue - Distance (Worst Lane)	7.3 m	
Ave. Queue Storage Ratio (Worst Lane)	0.01	
Total Effective Stops	226 veh/h	272 pers/h
Effective Stop Rate	0.31	0.31
Proportion Queued	0.18	0.18
Performance Index	16.8	16.8
Cost (Total)	424.92 \$/h	424.92 \$/h
Fuel Consumption (Total)	53.2 L/h	
Carbon Dioxide (Total)	127.8 kg/h	
Hydrocarbons (Total)	0.009 kg/h	
Carbon Monoxide (Total)	0.105 kg/h	
NOx (Total)	0.359 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 65.0% 12.4% 0.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	352,674 veh/y	423,209 pers/y
Delay	333 veh-h/y	400 pers-h/y
Effective Stops	108,683 veh/y	130,419 pers/y
Travel Distance	258,635 veh-km/y	310,362 pers-km/y
Travel Time	5,537 veh-h/y	6,644 pers-h/y
Cost	203,961 \$/y	203,961 \$/y
Fuel Consumption	25,518 L/y	
Carbon Dioxide	61,342 kg/y	
Hydrocarbons	4 kg/y	
Carbon Monoxide	51 kg/y	

NOx

172 kg/y

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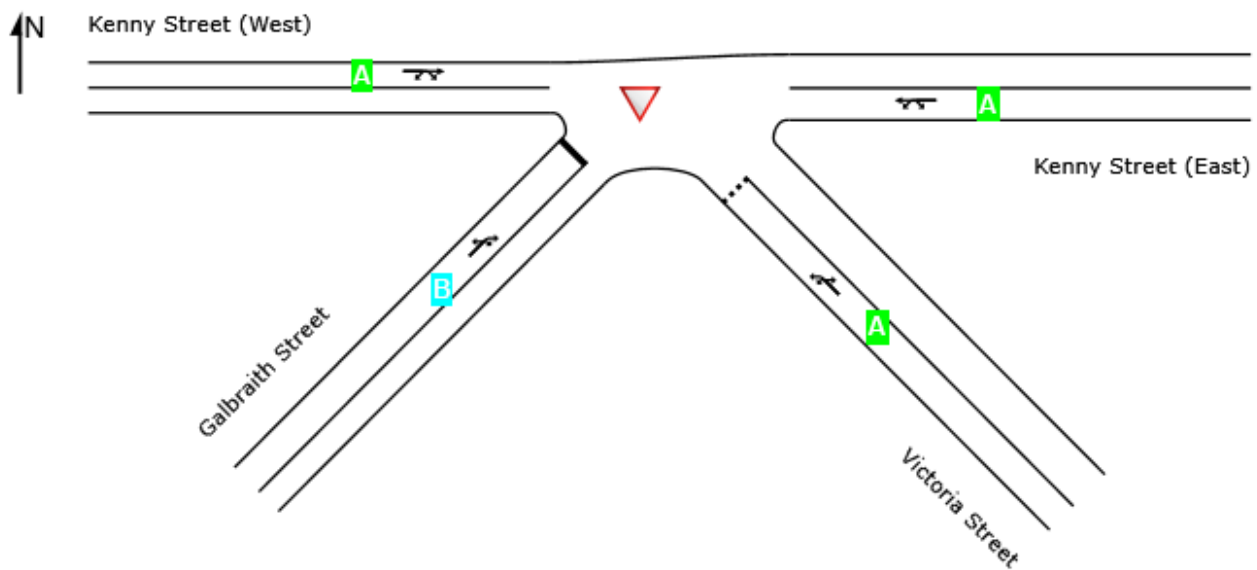
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [Kenny_Vic_Gal_AM_2019+LD (Site Folder: General)]

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

	Approaches				Intersection
	Southeast	East	West	Southwest	
LOS	A	NA	NA	B	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

Site: 101 [Kenny_Vic_Gal_AM_2048+HD (Site Folder: General)]

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

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	44.9 km/h	44.9 km/h
Travel Distance (Total)	904.4 veh-km/h	1085.3 pers-km/h
Travel Time (Total)	20.1 veh-h/h	24.2 pers-h/h
Desired Speed (Program)	50.0 km/h	
Speed Efficiency	0.90	
Travel Time Index	8.87	
Congestion Coefficient	1.11	
Demand Flows (Total)	1242 veh/h	1491 pers/h
Percent Heavy Vehicles (Demand)	9.2 %	
Degree of Saturation	0.583	
Practical Spare Capacity	37.1 %	
Effective Intersection Capacity	2129 veh/h	
Control Delay (Total)	1.98 veh-h/h	2.37 pers-h/h
Control Delay (Average)	5.7 sec	5.7 sec
Control Delay (Worst Lane)	17.1 sec	
Control Delay (Worst Movement)	23.8 sec	23.8 sec
Geometric Delay (Average)	2.2 sec	
Stop-Line Delay (Average)	3.5 sec	
Idling Time (Average)	1.7 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	3.7 veh	
95% Back of Queue - Distance (Worst Lane)	27.8 m	
Ave. Queue Storage Ratio (Worst Lane)	0.02	
Total Effective Stops	486 veh/h	583 pers/h
Effective Stop Rate	0.39	0.39
Proportion Queued	0.29	0.29
Performance Index	36.3	36.3
Cost (Total)	737.90 \$/h	737.90 \$/h
Fuel Consumption (Total)	91.6 L/h	
Carbon Dioxide (Total)	220.1 kg/h	
Hydrocarbons (Total)	0.016 kg/h	
Carbon Monoxide (Total)	0.182 kg/h	
NOx (Total)	0.623 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
 Delay Model: SIDRA Standard (Geometric Delay is included).
 Queue Model: SIDRA Standard.
 Site Model Variability Index (Iterations 3 to N): 0.0 %
 Number of Iterations: 3 (Maximum: 10)
 Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 80.6% 17.9% 0.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	596,211 veh/y	715,453 pers/y
Delay	949 veh-h/y	1,139 pers-h/y
Effective Stops	233,357 veh/y	280,029 pers/y
Travel Distance	434,135 veh-km/y	520,962 pers-km/y
Travel Time	9,665 veh-h/y	11,597 pers-h/y
Cost	354,193 \$/y	354,193 \$/y
Fuel Consumption	43,962 L/y	
Carbon Dioxide	105,660 kg/y	
Hydrocarbons	8 kg/y	
Carbon Monoxide	88 kg/y	

NOx

299 kg/y

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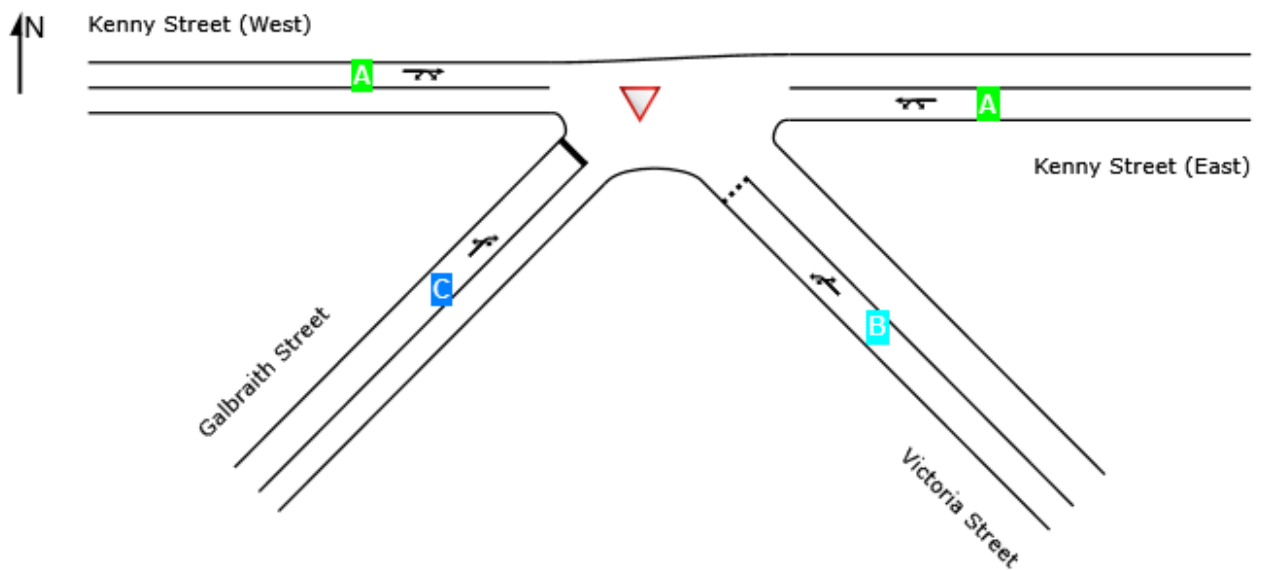
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [Kenny_Vic_Gal_AM_2048+HD (Site Folder: General)]

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

	Approaches				Intersection
	Southeast	East	West	Southwest	
LOS	B	NA	NA	C	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [Kenny_Vic_Gal_PM_2019+LD (Site Folder: General)]

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

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	46.9 km/h	46.9 km/h
Travel Distance (Total)	535.9 veh-km/h	643.0 pers-km/h
Travel Time (Total)	11.4 veh-h/h	13.7 pers-h/h
Desired Speed (Program)	50.0 km/h	
Speed Efficiency	0.94	
Travel Time Index	9.31	
Congestion Coefficient	1.07	
Demand Flows (Total)	731 veh/h	877 pers/h
Percent Heavy Vehicles (Demand)	9.6 %	
Degree of Saturation	0.232	
Practical Spare Capacity	322.9 %	
Effective Intersection Capacity	3152 veh/h	
Control Delay (Total)	0.66 veh-h/h	0.79 pers-h/h
Control Delay (Average)	3.2 sec	3.2 sec
Control Delay (Worst Lane)	10.8 sec	
Control Delay (Worst Movement)	12.9 sec	12.9 sec
Geometric Delay (Average)	2.2 sec	
Stop-Line Delay (Average)	1.0 sec	
Idling Time (Average)	0.2 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	1.1 veh	
95% Back of Queue - Distance (Worst Lane)	8.5 m	
Ave. Queue Storage Ratio (Worst Lane)	0.02	
Total Effective Stops	213 veh/h	255 pers/h
Effective Stop Rate	0.29	0.29
Proportion Queued	0.21	0.21
Performance Index	16.5	16.5
Cost (Total)	426.49 \$/h	426.49 \$/h
Fuel Consumption (Total)	54.4 L/h	
Carbon Dioxide (Total)	131.0 kg/h	
Hydrocarbons (Total)	0.009 kg/h	
Carbon Monoxide (Total)	0.108 kg/h	
NOx (Total)	0.386 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 63.3% 23.4% 0.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	350,653 veh/y	420,783 pers/y
Delay	316 veh-h/y	380 pers-h/y
Effective Stops	102,125 veh/y	122,551 pers/y
Travel Distance	257,218 veh-km/y	308,662 pers-km/y
Travel Time	5,486 veh-h/y	6,584 pers-h/y
Cost	204,713 \$/y	204,713 \$/y
Fuel Consumption	26,113 L/y	
Carbon Dioxide	62,873 kg/y	
Hydrocarbons	5 kg/y	
Carbon Monoxide	52 kg/y	

NOx

185 kg/y

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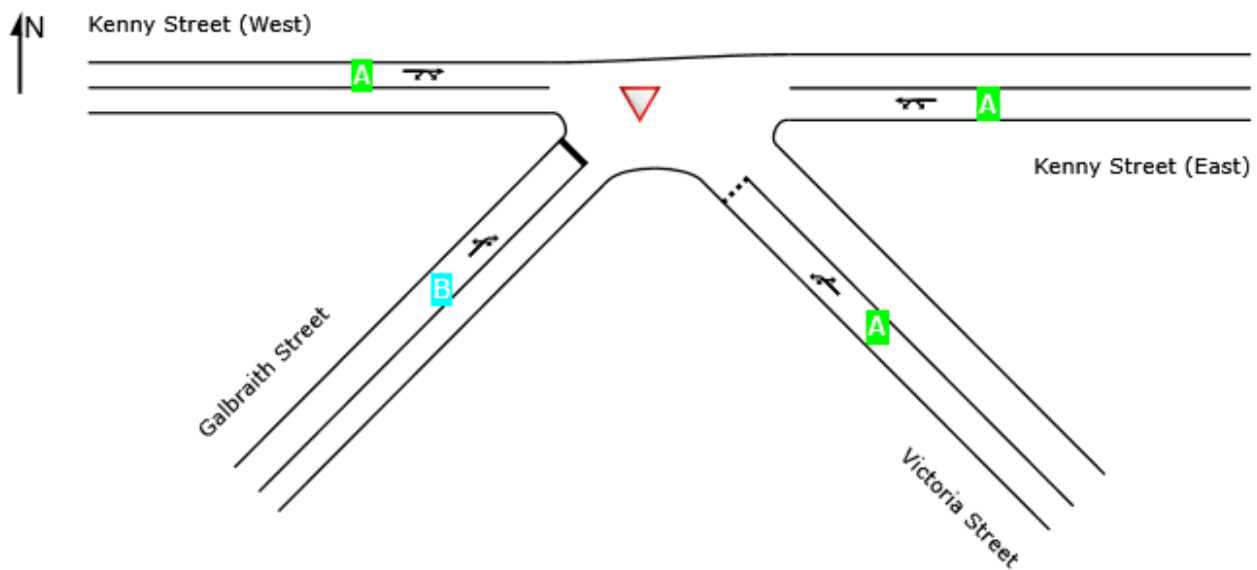
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [Kenny_Vic_Gal_PM_2019+LD (Site Folder: General)]

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

	Approaches				Intersection
	Southeast	East	West	Southwest	
LOS	A	NA	NA	B	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [Kenny_Vic_Gal_PM_2048+HD (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	45.4 km/h	45.4 km/h
Travel Distance (Total)	884.1 veh-km/h	1060.9 pers-km/h
Travel Time (Total)	19.5 veh-h/h	23.4 pers-h/h
Desired Speed (Program)	50.0 km/h	
Speed Efficiency	0.91	
Travel Time Index	8.98	
Congestion Coefficient	1.10	
Demand Flows (Total)	1217 veh/h	1460 pers/h
Percent Heavy Vehicles (Demand)	9.7 %	
Degree of Saturation	0.462	
Practical Spare Capacity	112.2 %	
Effective Intersection Capacity	2635 veh/h	
Control Delay (Total)	1.73 veh-h/h	2.07 pers-h/h
Control Delay (Average)	5.1 sec	5.1 sec
Control Delay (Worst Lane)	15.3 sec	
Control Delay (Worst Movement)	21.3 sec	21.3 sec
Geometric Delay (Average)	2.0 sec	
Stop-Line Delay (Average)	3.1 sec	
Idling Time (Average)	1.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	3.9 veh	
95% Back of Queue - Distance (Worst Lane)	29.8 m	
Ave. Queue Storage Ratio (Worst Lane)	0.08	
Total Effective Stops	404 veh/h	485 pers/h
Effective Stop Rate	0.33	0.33
Proportion Queued	0.32	0.32
Performance Index	34.1	34.1
Cost (Total)	726.39 \$/h	726.39 \$/h
Fuel Consumption (Total)	92.6 L/h	
Carbon Dioxide (Total)	222.9 kg/h	
Hydrocarbons (Total)	0.016 kg/h	
Carbon Monoxide (Total)	0.185 kg/h	
NOx (Total)	0.667 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 0.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 78.6% 34.2% 0.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	584,084 veh/y	700,901 pers/y
Delay	829 veh-h/y	995 pers-h/y
Effective Stops	193,827 veh/y	232,593 pers/y
Travel Distance	424,346 veh-km/y	509,216 pers-km/y
Travel Time	9,348 veh-h/y	11,217 pers-h/y
Cost	348,667 \$/y	348,667 \$/y
Fuel Consumption	44,454 L/y	
Carbon Dioxide	107,008 kg/y	
Hydrocarbons	8 kg/y	
Carbon Monoxide	89 kg/y	

NOx

320 kg/y

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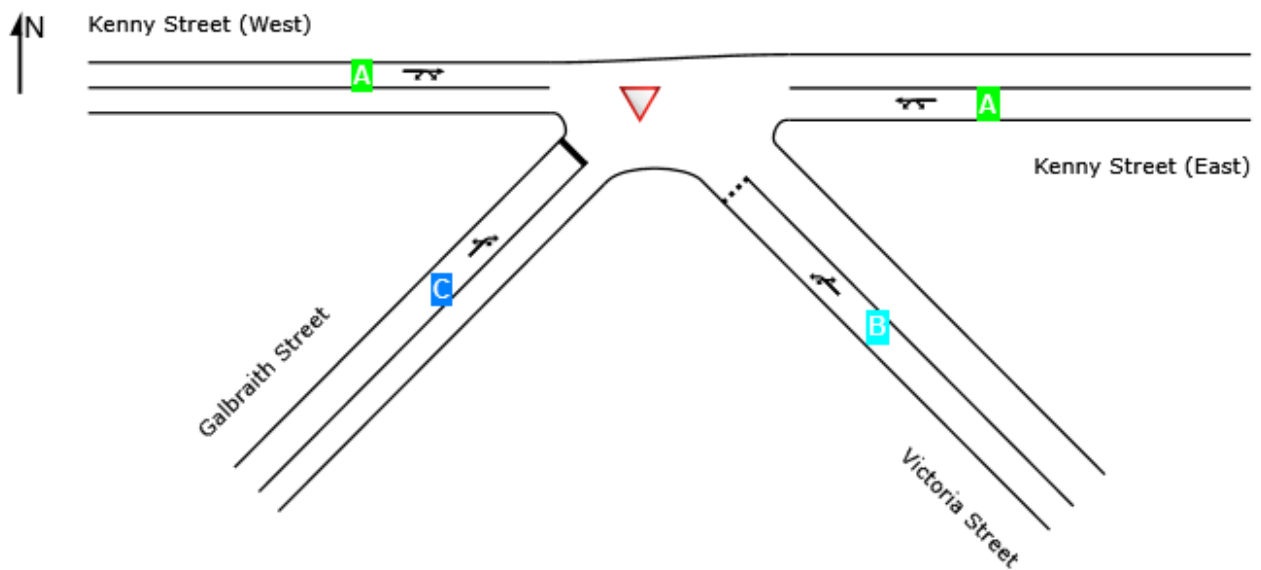
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [Kenny_Vic_Gal_PM_2048+HD (Site Folder: General)]

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

	Approaches				Intersection
	Southeast	East	West	Southwest	
LOS	B	NA	NA	C	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

Site: 101 [SH2_Kenny_AM_2019+LD (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	44.4 km/h	44.4 km/h
Travel Distance (Total)	1343.2 veh-km/h	1611.9 pers-km/h
Travel Time (Total)	30.2 veh-h/h	36.3 pers-h/h
Desired Speed (Program)	59.8 km/h	
Speed Efficiency	0.74	
Travel Time Index	7.14	
Congestion Coefficient	1.35	
Demand Flows (Total)	1520 veh/h	1824 pers/h
Percent Heavy Vehicles (Demand)	10.2 %	
Degree of Saturation	0.992	
Practical Spare Capacity	-19.3 %	
Effective Intersection Capacity	1533 veh/h	
Control Delay (Total)	8.52 veh-h/h	10.22 pers-h/h
Control Delay (Average)	20.2 sec	20.2 sec
Control Delay (Worst Lane)	80.3 sec	
Control Delay (Worst Movement)	91.7 sec	91.7 sec
Geometric Delay (Average)	3.3 sec	
Stop-Line Delay (Average)	16.8 sec	
Idling Time (Average)	10.8 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	17.2 veh	
95% Back of Queue - Distance (Worst Lane)	131.4 m	
Ave. Queue Storage Ratio (Worst Lane)	0.35	
Total Effective Stops	1225 veh/h	1470 pers/h
Effective Stop Rate	0.81	0.81
Proportion Queued	0.34	0.34
Performance Index	67.2	67.2
Cost (Total)	1223.58 \$/h	1223.58 \$/h
Fuel Consumption (Total)	174.2 L/h	
Carbon Dioxide (Total)	418.4 kg/h	
Hydrocarbons (Total)	0.036 kg/h	
Carbon Monoxide (Total)	0.467 kg/h	
NOx (Total)	1.390 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 1.0 %

Number of Iterations: 3 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 81.6% 26.6% 1.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	729,600 veh/y	875,520 pers/y
Delay	4,089 veh-h/y	4,907 pers-h/y
Effective Stops	588,124 veh/y	705,749 pers/y
Travel Distance	644,748 veh-km/y	773,698 pers-km/y
Travel Time	14,516 veh-h/y	17,419 pers-h/y
Cost	587,317 \$/y	587,317 \$/y
Fuel Consumption	83,595 L/y	
Carbon Dioxide	200,835 kg/y	
Hydrocarbons	17 kg/y	
Carbon Monoxide	224 kg/y	
NOx	667 kg/y	

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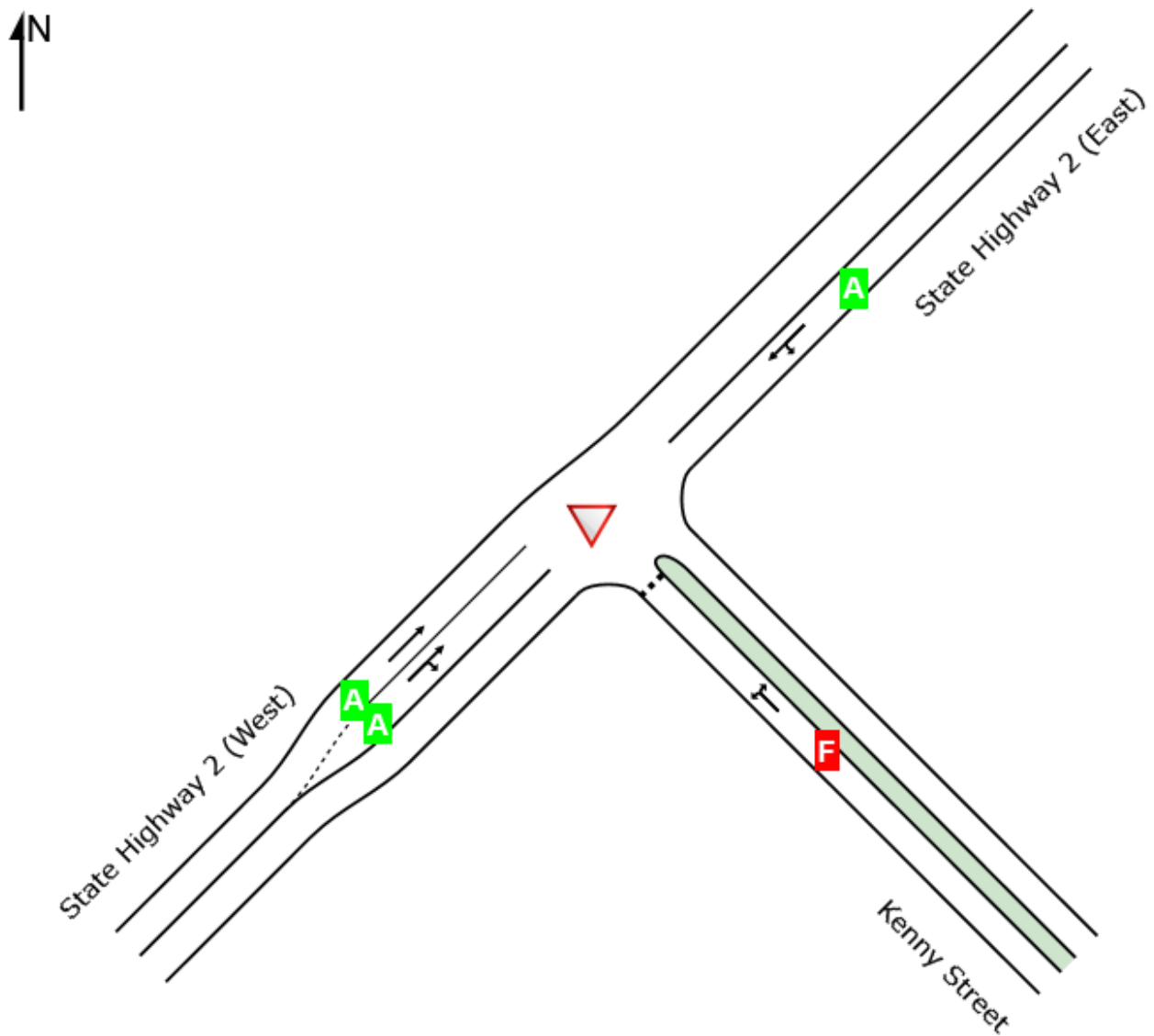
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [SH2_Kenny_AM_2019+LD (Site Folder: General)]

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	F	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [SH2_Kenny_AM_2048 (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	3.6 km/h	3.6 km/h
Travel Distance (Total)	2190.3 veh-km/h	2628.3 pers-km/h
Travel Time (Total)	615.4 veh-h/h	738.5 pers-h/h
Desired Speed (Program)	59.5 km/h	
Speed Efficiency	0.06	
Travel Time Index	0.00	
Congestion Coefficient	10.00	
Demand Flows (Total)	2404 veh/h	2885 pers/h
Percent Heavy Vehicles (Demand)	10.1 %	
Degree of Saturation	7.470	
Practical Spare Capacity	-89.3 %	
Effective Intersection Capacity	322 veh/h	
Control Delay (Total)	573.83 veh-h/h	688.59 pers-h/h
Control Delay (Average)	859.2 sec	859.2 sec
Control Delay (Worst Lane)	5861.7 sec	
Control Delay (Worst Movement)	5871.2 sec	5871.2 sec
Geometric Delay (Average)	3.1 sec	
Stop-Line Delay (Average)	856.1 sec	
Idling Time (Average)	855.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	205.4 veh	
95% Back of Queue - Distance (Worst Lane)	1573.1 m	
Ave. Queue Storage Ratio (Worst Lane)	4.22	
Total Effective Stops	2319 veh/h	2782 pers/h
Effective Stop Rate	0.96	0.96
Proportion Queued	0.42	0.42
Performance Index	997.3	997.3
Cost (Total)	16988.27 \$/h	16988.27 \$/h
Fuel Consumption (Total)	1032.5 L/h	
Carbon Dioxide (Total)	2464.3 kg/h	
Hydrocarbons (Total)	0.417 kg/h	
Carbon Monoxide (Total)	3.129 kg/h	
NOx (Total)	5.161 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.3 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.5% 1.6% 1.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,154,021 veh/y	1,384,826 pers/y
Delay	275,436 veh-h/y	330,524 pers-h/y
Effective Stops	1,112,969 veh/y	1,335,563 pers/y
Travel Distance	1,051,333 veh-km/y	1,261,599 pers-km/y
Travel Time	295,395 veh-h/y	354,475 pers-h/y
Cost	8,154,368 \$/y	8,154,368 \$/y
Fuel Consumption	495,601 L/y	
Carbon Dioxide	1,182,887 kg/y	
Hydrocarbons	200 kg/y	
Carbon Monoxide	1,502 kg/y	
NOx	2,477 kg/y	

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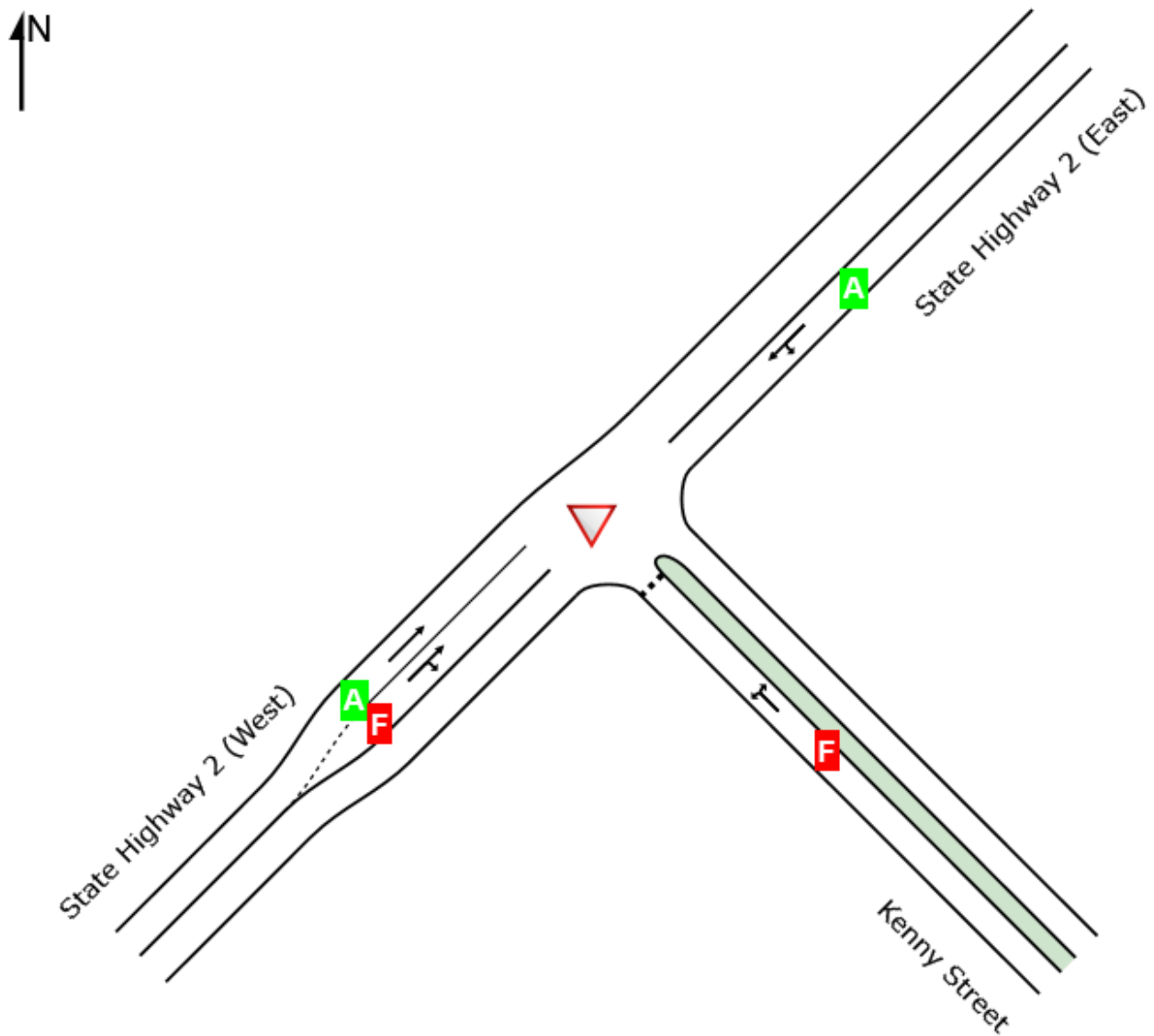
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [SH2_Kenny_AM_2048 (Site Folder: General)]

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	F	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

Site: 101 [SH2_Kenny_AM_2048+HD (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	1.2 km/h	1.2 km/h
Travel Distance (Total)	2409.5 veh-km/h	2891.4 pers-km/h
Travel Time (Total)	2075.6 veh-h/h	2490.8 pers-h/h
Desired Speed (Program)	59.9 km/h	
Speed Efficiency	0.02	
Travel Time Index	0.00	
Congestion Coefficient	10.00	
Demand Flows (Total)	2735 veh/h	3282 pers/h
Percent Heavy Vehicles (Demand)	10.2 %	
Degree of Saturation	14.655	
Practical Spare Capacity	-94.5 %	
Effective Intersection Capacity	187 veh/h	
Control Delay (Total)	2022.47 veh-h/h	2426.96 pers-h/h
Control Delay (Average)	2662.4 sec	2662.4 sec
Control Delay (Worst Lane)	12320.3 sec	
Control Delay (Worst Movement)	12326.0 sec	12326.0 sec
Geometric Delay (Average)	3.3 sec	
Stop-Line Delay (Average)	2659.0 sec	
Idling Time (Average)	2661.7 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	372.0 veh	
95% Back of Queue - Distance (Worst Lane)	2849.1 m	
Ave. Queue Storage Ratio (Worst Lane)	7.64	
Total Effective Stops	3696 veh/h	4435 pers/h
Effective Stop Rate	1.35	1.35
Proportion Queued	0.43	0.43
Performance Index	2801.2	2801.2
Cost (Total)	55773.61 \$/h	55773.61 \$/h
Fuel Consumption (Total)	2998.5 L/h	
Carbon Dioxide (Total)	7146.3 kg/h	
Hydrocarbons (Total)	1.345 kg/h	
Carbon Monoxide (Total)	9.329 kg/h	
NOx (Total)	13.002 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.7 %

Number of Iterations: 8 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 1.7% 1.1% 0.8%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,312,674 veh/y	1,575,209 pers/y
Delay	970,783 veh-h/y	1,164,940 pers-h/y
Effective Stops	1,773,895 veh/y	2,128,675 pers/y
Travel Distance	1,156,573 veh-km/y	1,387,887 pers-km/y
Travel Time	996,308 veh-h/y	1,195,570 pers-h/y
Cost	26,771,330 \$/y	26,771,330 \$/y
Fuel Consumption	1,439,282 L/y	
Carbon Dioxide	3,430,216 kg/y	
Hydrocarbons	646 kg/y	
Carbon Monoxide	4,478 kg/y	
NOx	6,241 kg/y	

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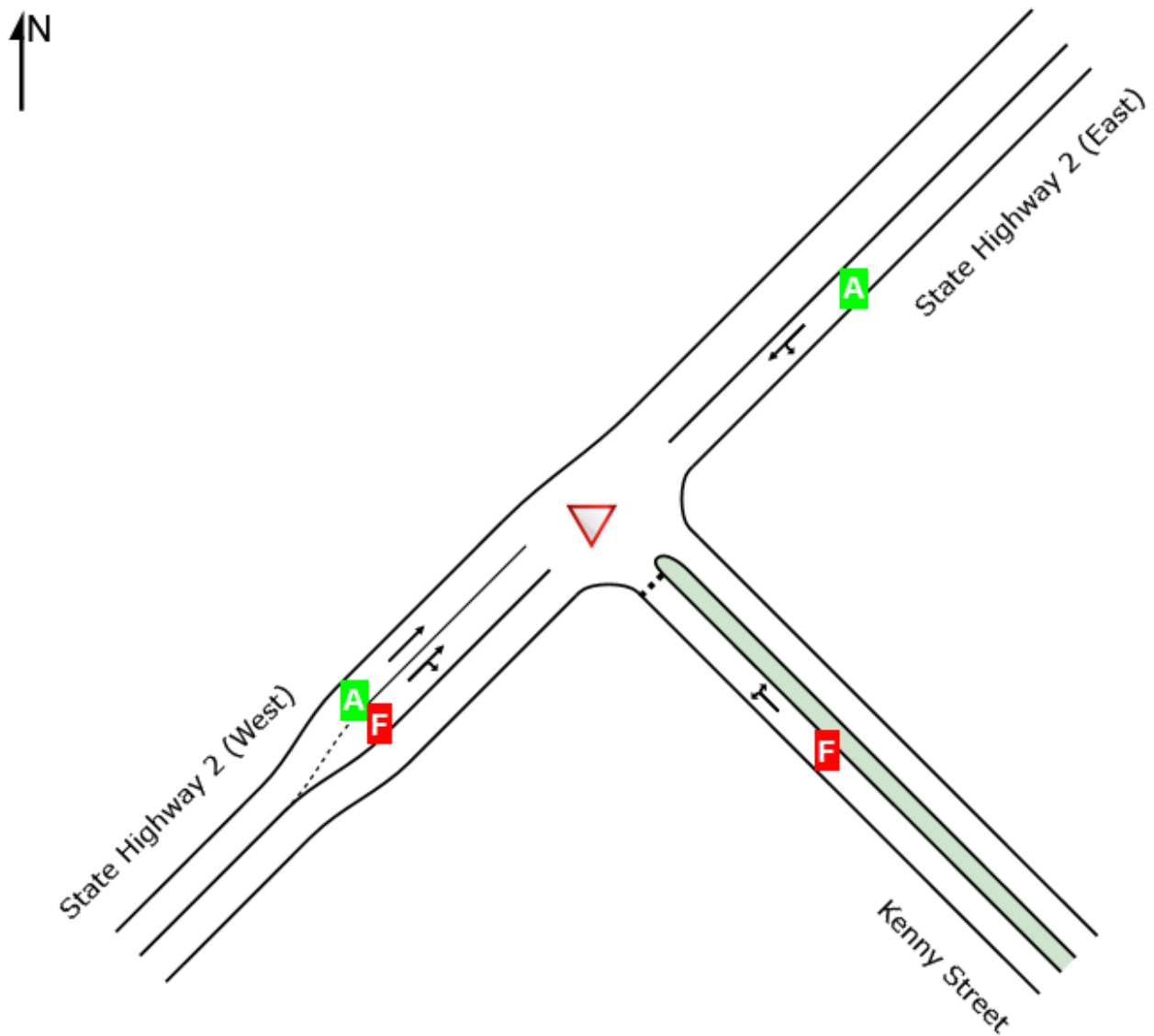
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [SH2_Kenny_AM_2048+HD (Site Folder: General)]

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	F	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [SH2_Kenny_PM_2019+LD (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	50.7 km/h	50.7 km/h
Travel Distance (Total)	1341.8 veh-km/h	1610.2 pers-km/h
Travel Time (Total)	26.5 veh-h/h	31.8 pers-h/h
Desired Speed (Program)	59.8 km/h	
Speed Efficiency	0.85	
Travel Time Index	8.29	
Congestion Coefficient	1.18	
Demand Flows (Total)	1518 veh/h	1821 pers/h
Percent Heavy Vehicles (Demand)	10.2 %	
Degree of Saturation	0.840	
Practical Spare Capacity	-4.7 %	
Effective Intersection Capacity	1808 veh/h	
Control Delay (Total)	4.88 veh-h/h	5.86 pers-h/h
Control Delay (Average)	11.6 sec	11.6 sec
Control Delay (Worst Lane)	43.4 sec	
Control Delay (Worst Movement)	55.3 sec	55.3 sec
Geometric Delay (Average)	3.4 sec	
Stop-Line Delay (Average)	8.2 sec	
Idling Time (Average)	5.1 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	7.2 veh	
95% Back of Queue - Distance (Worst Lane)	54.9 m	
Ave. Queue Storage Ratio (Worst Lane)	0.15	
Total Effective Stops	880 veh/h	1056 pers/h
Effective Stop Rate	0.58	0.58
Proportion Queued	0.34	0.34
Performance Index	46.4	46.4
Cost (Total)	1114.49 \$/h	1114.49 \$/h
Fuel Consumption (Total)	166.1 L/h	
Carbon Dioxide (Total)	399.1 kg/h	
Hydrocarbons (Total)	0.033 kg/h	
Carbon Monoxide (Total)	0.444 kg/h	
NOx (Total)	1.324 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 1.1 %

Number of Iterations: 4 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 31.7% 1.5% 0.8%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	728,590 veh/y	874,308 pers/y
Delay	2,344 veh-h/y	2,813 pers-h/y
Effective Stops	422,421 veh/y	506,905 pers/y
Travel Distance	644,066 veh-km/y	772,879 pers-km/y
Travel Time	12,713 veh-h/y	15,256 pers-h/y
Cost	534,954 \$/y	534,954 \$/y
Fuel Consumption	79,745 L/y	
Carbon Dioxide	191,584 kg/y	
Hydrocarbons	16 kg/y	
Carbon Monoxide	213 kg/y	
NOx	635 kg/y	

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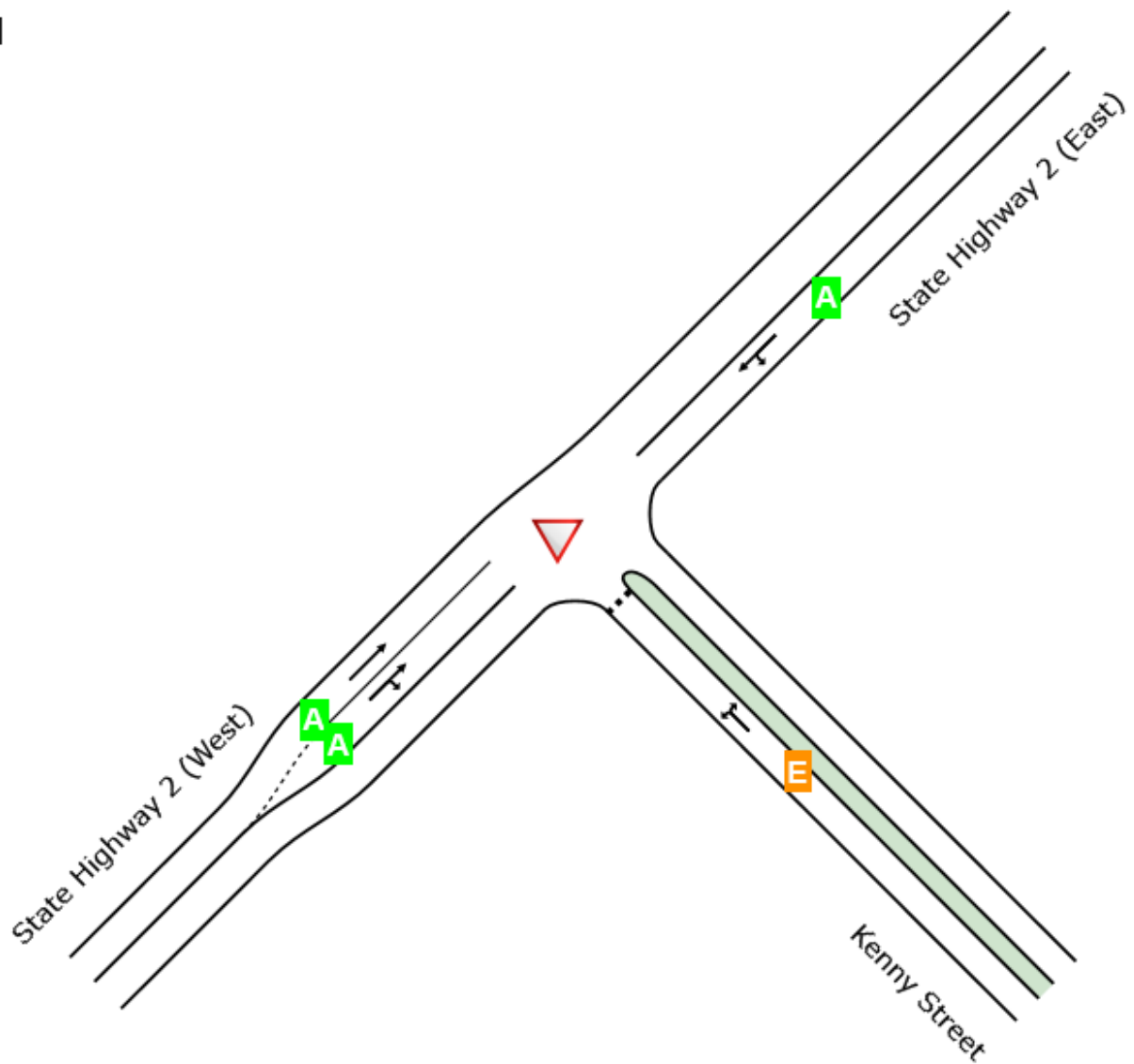
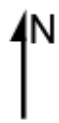
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [SH2_Kenny_PM_2019+LD (Site Folder: General)]

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	E	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [SH2_Kenny_PM_2048 (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	3.6 km/h	3.6 km/h
Travel Distance (Total)	2190.3 veh-km/h	2628.3 pers-km/h
Travel Time (Total)	615.4 veh-h/h	738.5 pers-h/h
Desired Speed (Program)	59.5 km/h	
Speed Efficiency	0.06	
Travel Time Index	0.00	
Congestion Coefficient	10.00	
Demand Flows (Total)	2404 veh/h	2885 pers/h
Percent Heavy Vehicles (Demand)	10.1 %	
Degree of Saturation	7.470	
Practical Spare Capacity	-89.3 %	
Effective Intersection Capacity	322 veh/h	
Control Delay (Total)	573.83 veh-h/h	688.59 pers-h/h
Control Delay (Average)	859.2 sec	859.2 sec
Control Delay (Worst Lane)	5861.7 sec	
Control Delay (Worst Movement)	5871.2 sec	5871.2 sec
Geometric Delay (Average)	3.1 sec	
Stop-Line Delay (Average)	856.1 sec	
Idling Time (Average)	855.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	205.4 veh	
95% Back of Queue - Distance (Worst Lane)	1573.1 m	
Ave. Queue Storage Ratio (Worst Lane)	4.22	
Total Effective Stops	2319 veh/h	2782 pers/h
Effective Stop Rate	0.96	0.96
Proportion Queued	0.42	0.42
Performance Index	997.3	997.3
Cost (Total)	16988.27 \$/h	16988.27 \$/h
Fuel Consumption (Total)	1032.5 L/h	
Carbon Dioxide (Total)	2464.3 kg/h	
Hydrocarbons (Total)	0.417 kg/h	
Carbon Monoxide (Total)	3.129 kg/h	
NOx (Total)	5.161 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 2.3 %

Number of Iterations: 6 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 2.5% 1.6% 1.0%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,154,021 veh/y	1,384,826 pers/y
Delay	275,436 veh-h/y	330,524 pers-h/y
Effective Stops	1,112,969 veh/y	1,335,563 pers/y
Travel Distance	1,051,333 veh-km/y	1,261,599 pers-km/y
Travel Time	295,395 veh-h/y	354,475 pers-h/y
Cost	8,154,368 \$/y	8,154,368 \$/y
Fuel Consumption	495,601 L/y	
Carbon Dioxide	1,182,887 kg/y	
Hydrocarbons	200 kg/y	
Carbon Monoxide	1,502 kg/y	
NOx	2,477 kg/y	

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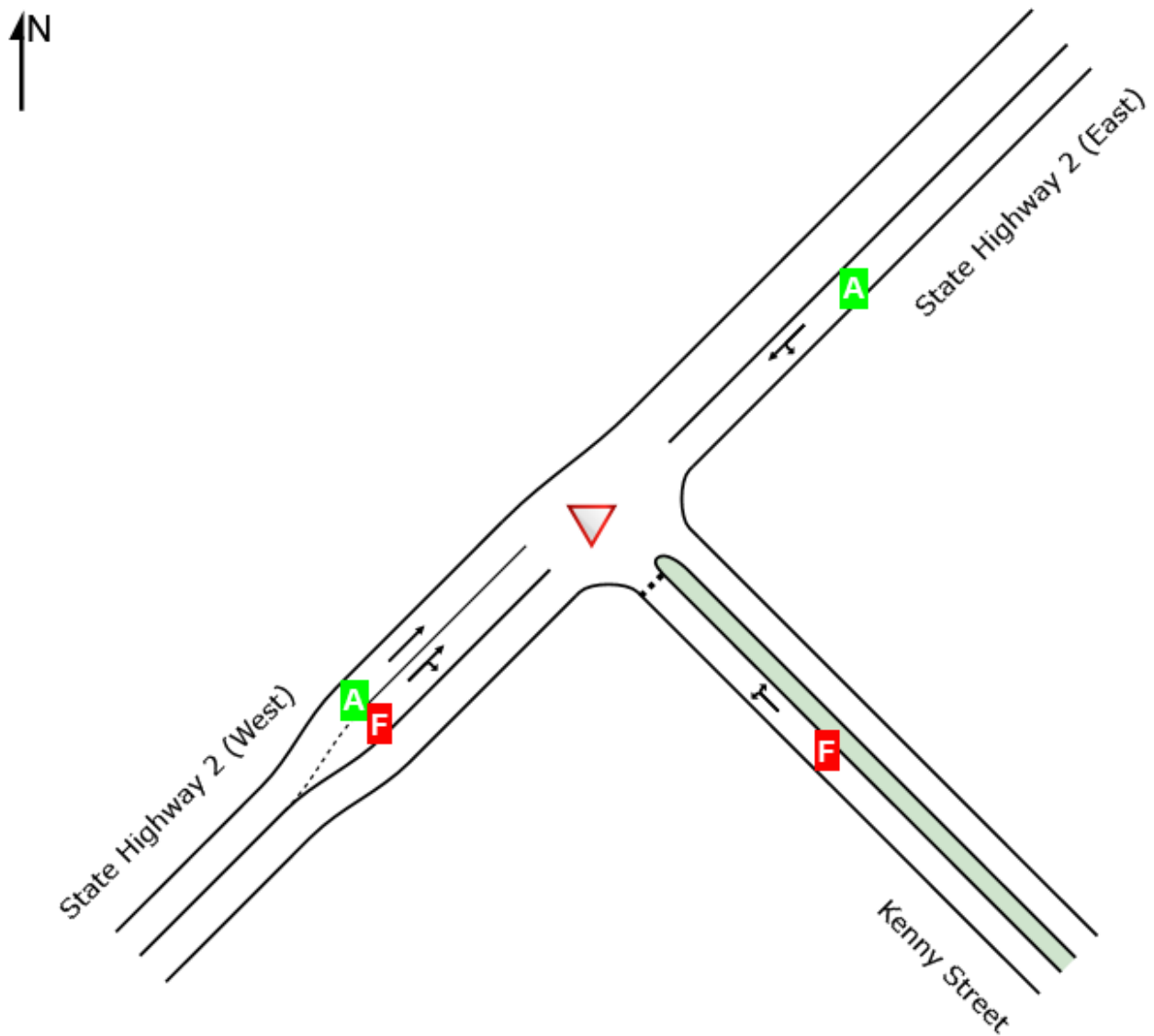
LANE LEVEL OF SERVICE

Lane Level of Service

▽ Site: 101 [SH2_Kenny_PM_2048 (Site Folder: General)]

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	F	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

INTERSECTION SUMMARY

▼ Site: 101 [SH2_Kenny_PM_2048+HD (Site Folder: General)]

New Site

Site Category: (None)

Give-Way (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Travel Speed (Average)	1.4 km/h	1.4 km/h
Travel Distance (Total)	2409.5 veh-km/h	2891.4 pers-km/h
Travel Time (Total)	1739.0 veh-h/h	2086.8 pers-h/h
Desired Speed (Program)	59.9 km/h	
Speed Efficiency	0.02	
Travel Time Index	0.00	
Congestion Coefficient	10.00	
Demand Flows (Total)	2735 veh/h	3282 pers/h
Percent Heavy Vehicles (Demand)	10.2 %	
Degree of Saturation	15.234	
Practical Spare Capacity	-94.7 %	
Effective Intersection Capacity	180 veh/h	
Control Delay (Total)	1685.10 veh-h/h	2022.12 pers-h/h
Control Delay (Average)	2218.3 sec	2218.3 sec
Control Delay (Worst Lane)	12852.7 sec	
Control Delay (Worst Movement)	12860.0 sec	12860.0 sec
Geometric Delay (Average)	3.4 sec	
Stop-Line Delay (Average)	2214.9 sec	
Idling Time (Average)	2219.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	296.3 veh	
95% Back of Queue - Distance (Worst Lane)	2269.6 m	
Ave. Queue Storage Ratio (Worst Lane)	6.09	
Total Effective Stops	3503 veh/h	4203 pers/h
Effective Stop Rate	1.28	1.28
Proportion Queued	0.33	0.33
Performance Index	2355.1	2355.1
Cost (Total)	46843.13 \$/h	46843.13 \$/h
Fuel Consumption (Total)	2548.6 L/h	
Carbon Dioxide (Total)	6074.4 kg/h	
Hydrocarbons (Total)	1.130 kg/h	
Carbon Monoxide (Total)	7.893 kg/h	
NOx (Total)	11.192 kg/h	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Site Model Variability Index (Iterations 3 to N): 3.3 %

Number of Iterations: 10 (Maximum: 10)

Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 1.6% 1.2% 0.9%

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,312,674 veh/y	1,575,209 pers/y
Delay	808,850 veh-h/y	970,620 pers-h/y
Effective Stops	1,681,313 veh/y	2,017,576 pers/y
Travel Distance	1,156,548 veh-km/y	1,387,857 pers-km/y
Travel Time	834,735 veh-h/y	1,001,682 pers-h/y
Cost	22,484,700 \$/y	22,484,700 \$/y
Fuel Consumption	1,223,308 L/y	
Carbon Dioxide	2,915,700 kg/y	
Hydrocarbons	542 kg/y	
Carbon Monoxide	3,789 kg/y	
NOx	5,372 kg/y	

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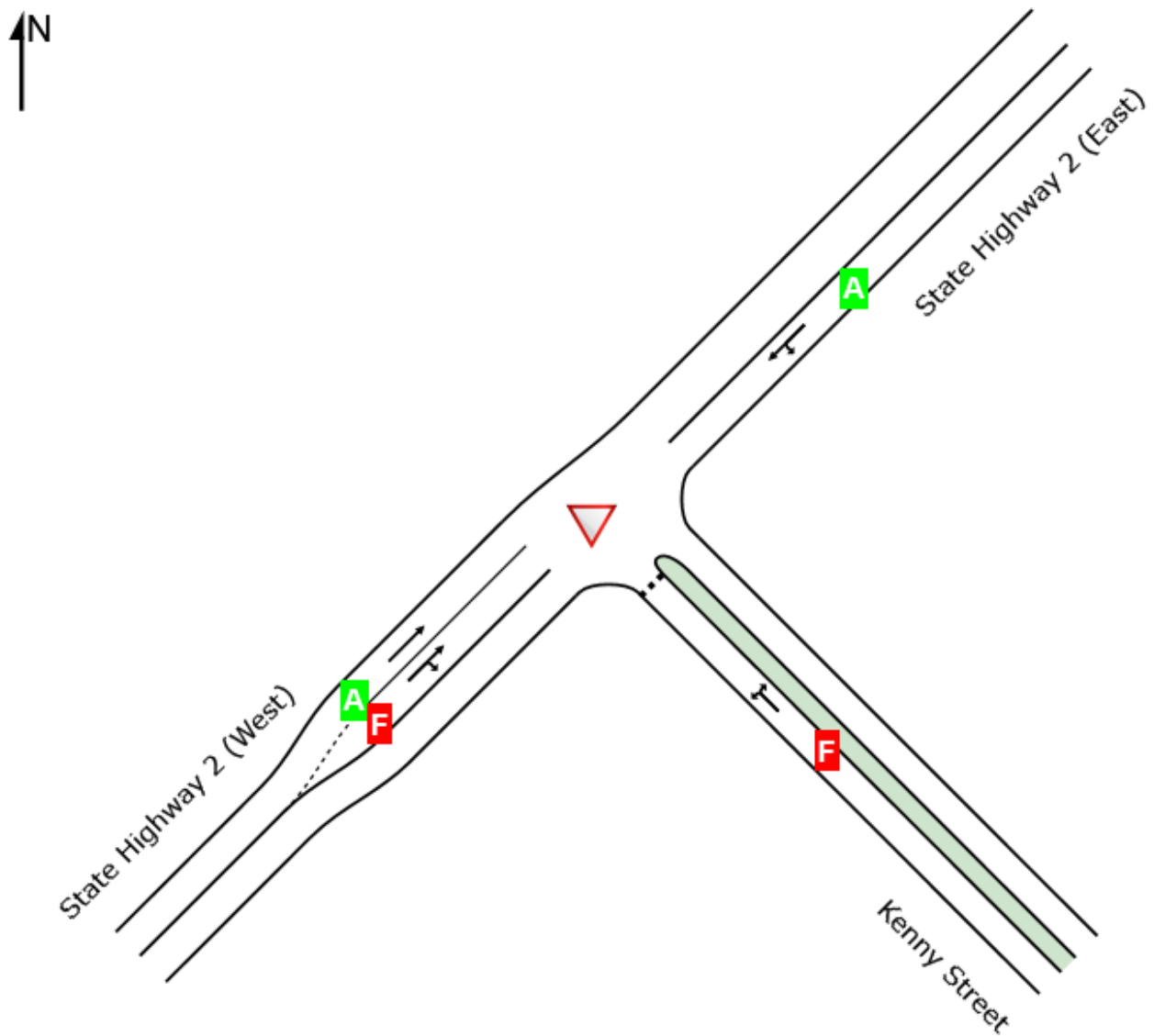
LANE LEVEL OF SERVICE

Lane Level of Service

 **Site: 101 [SH2_Kenny_PM_2048+HD (Site Folder: General)]**

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

	Approaches			Intersection
	Southeast	Northeast	Southwest	
LOS	F	NA	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

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