LBC Traffic Engineers

Transport Assessment

Proposed Private Plan Change

100 – 110 Te Moana Road

Waikanae

18 April 2025

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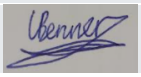
Signature	Luke Benner, NZDE (Civil) 

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1 Introduction

This report has been prepared as part of an application for a private plan change to the Kapiti Coast District Council (KCDC) at 100 and 110 Te Moana Road, Waikanae. The proposed private plan change seeks to rezone the existing site from rural to general residential.

The purpose of this report is to provide a detailed transport assessment including a review of the existing transport network including roads, intersections, traffic volumes & speeds, road safety performance, public transport and walking and cycling provision. The assessment includes an assessment of transport effects covering traffic generation, trip distribution, performance of the nearby interchange, road safety and sustainable transport including identification of measures to mitigate against transport effects.

The assessment goes on to consider the proposed plan change with respect to the objectives and policies of the transport chapter of the Operative District Plan as well alignment with key focus areas of Kapiti Coast District Council Sustainable Transport Strategy.

2 Site Location

The site is located at 100 and 110 Te Moana Road, Waikanae with the combined site being irregular in shape with a wide frontage onto Te Moana Road. The site borders the Kapiti Expressway (SH1) to the east with a small residential subdivision located to the west (Fairway Oaks Drive) and a large residentially zoned site (also referred to as Ngarara Farms elsewhere in this report) and the Waikanae Golf Club to the north. The site is located within 1.5km of Waikanae Beach and within 4km of the town centre and railway station.

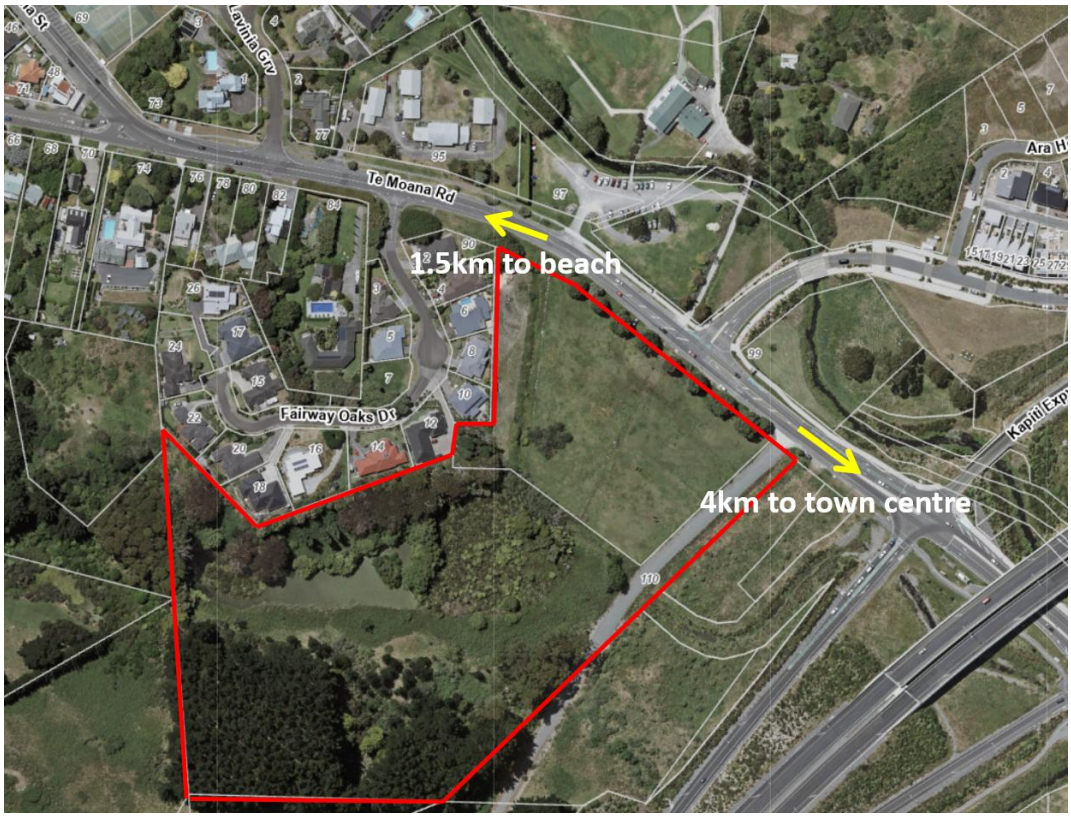


Figure 1 – Site Location.

3 Existing Transport Environment

3.1 Te Moana Road

The site fronts directly onto Te Moana Road which under the Operative District Plan (ODP) is classified as a major community connector route. The transport network hierarchy of the district plan has adopted the classifications of NZTA's One Network Framework (ONF) which replaced the One Network Road Classification (ONRC) in recent years.

Under the ODP transport network hierarchy this classification appears to align well with the function of Te Moana Road as it provides an access and through route function between the residential areas of Waikanae Beach and the rest of Waikanae including the town centre, golf club and the Kapiti Expressway.

Te Moana Road past the front of the site contains a reasonably wide sealed road shoulder with parking prohibited along it, followed by a traffic lane in each direction. On the northern side of the road there is a marked cycle lane followed by a concrete footpath. Te Moana Road features a wide road reserve with grassed berms on both sides of the road and street trees located in parts. While there are "no stopping" lines along the southern side of the road nearest the site, vehicles have been observed to commonly park on the grassed berm.

To the west of the site (within 80 metres) is the T intersection of Te Ara Kawakahia with Te Moana Road. This side road provides access to the Ngarara Development Area that is expected to continue growing over the coming years (enabled for 900 dwellings) with the intersection containing a marked right turn bay for vehicles turning right from Te Moana Road as well as informal pedestrian crossing facilities consisting of drop ramps and a central refuge island.

Further west there are two residential side streets (Fairway Oaks Drive & Lavinia Grove) that operate under standard give way controls for vehicles turning onto Te Moana Road.

3.2 Expressway Interchange

To the east of the site is the Te Moana Road/Kapiti Expressway Interchange, which contains two sets of traffic signals that are monitored by the Wellington Traffic Operations Centre (WTOC) on behalf of KCDC. Information on the operation of interchange was provided by WTOC including traffic count data, cycle and phase times for the 16th September 2024.

The signalised interchange operates as one coordinated site with cycle times varying based on the different traffic demands throughout the day. The interchange includes several signalised crossings for pedestrians with a dual cycle/pedestrian crossing located on the eastern side of the interchange, providing connectivity for the north/south shared path facility adjacent to the Kapiti Expressway.

Traffic count data provided by WTOC in 15-minute intervals for the interchange confirms that the morning peak hour is 8:00-9:00am (with 8:30am being the busiest time) with the afternoon peak being between 4:30pm-5:30pm. To assist with understanding how the interchange currently operates at peak times a model was created using the intersection modelling software SIDRA. As part of this exercise the corresponding AM and Peak hours were modelled at the interchange with the detailed results provided in attachment 1 covering performance of the interchange, level of service, average queue lengths and average delay on each approach.

The outputs from the model confirm that during the AM & PM peak hours most of the cycle time is given to the east-west movement along Te Moana Road, where the demand is greatest. As

can be expected during the morning peak hour the greatest delays are then experienced on the expressway offramps, with a mitigating factor being that demand is lower on these approaches and so the vehicle queues are not excessive. Arrival traffic flows are however higher on the northbound expressway offramp as well as from the east approach along Te Moana Road during the evening PM peak, with delays minimised on these approaches at these times to avoid excessive queuing.

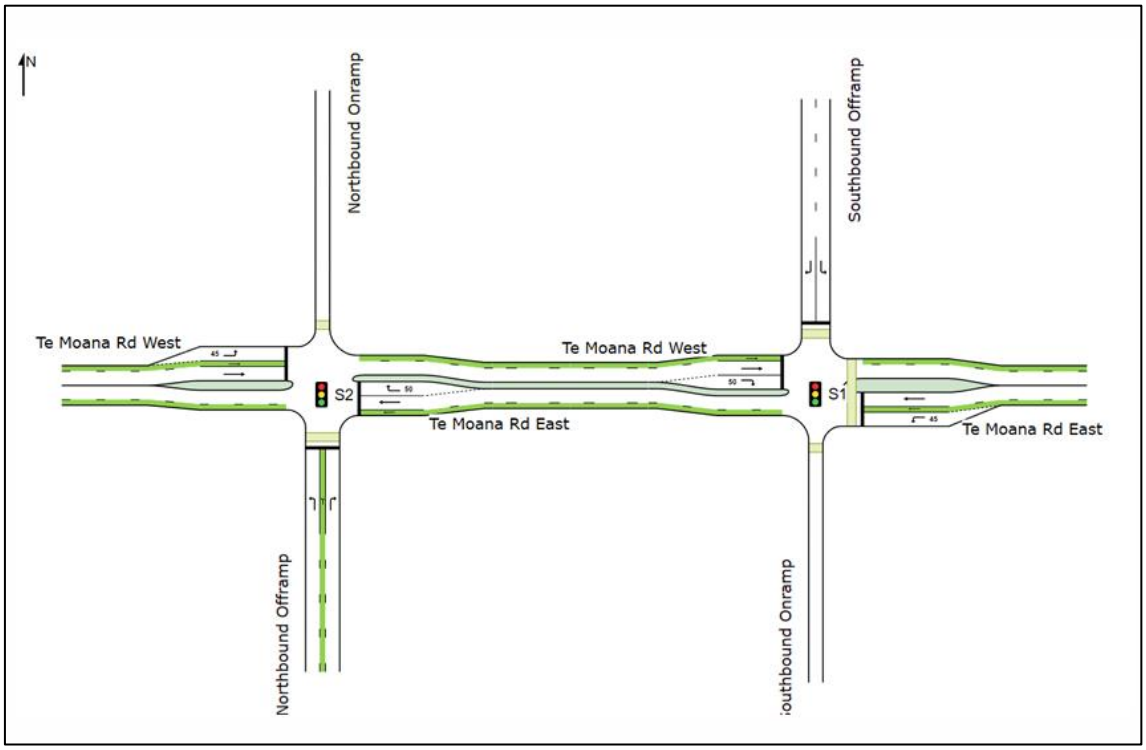


Figure 2 – Layout of Te Moana Rd/Kapiti Expressway Interchange – Source (SIDRA)

In addition to modelling of the interchange, footage was also provided for the AM and PM peak periods of the interchange by WTOC, with this reviewed to assist in validating the outputs from the model. Snapshots of the key approaches to the interchange are provided in figures 3, 4 and 5 which appears to show consistent queue lengths of that produced in the modelling.

Figure 3 – Morning peak hour queuing midblock at the interchange.

Figure 4 – Morning peak hour queueing on western approach to interchange.

Figure 5 – PM peak hour queuing on northbound expressway offramp.

3.3 Traffic Volumes & Speeds

Kapiti Coast District Council regularly monitors traffic volumes across its transport network. Te Moana Road has an annual daily traffic volume (ADT) of 10,002 vehicles per day with 4% estimated to be heavy vehicles. Source – Mobile Road. As part of understanding the existing transport environment, TomTom GPS speed data has been exported for the section of Te Moana Road fronting the site.

This data provides a representative sample of traffic along Te Moana Road and their corresponding operating speeds. As shown in figure 6, the average operating speed is 47.5 km/h while the 85th percentile speeds are 55km/h. These speeds are considered to be consistent with the road environment in this location, whereby the nearby interchange is largely free flowing outside of the peaks.

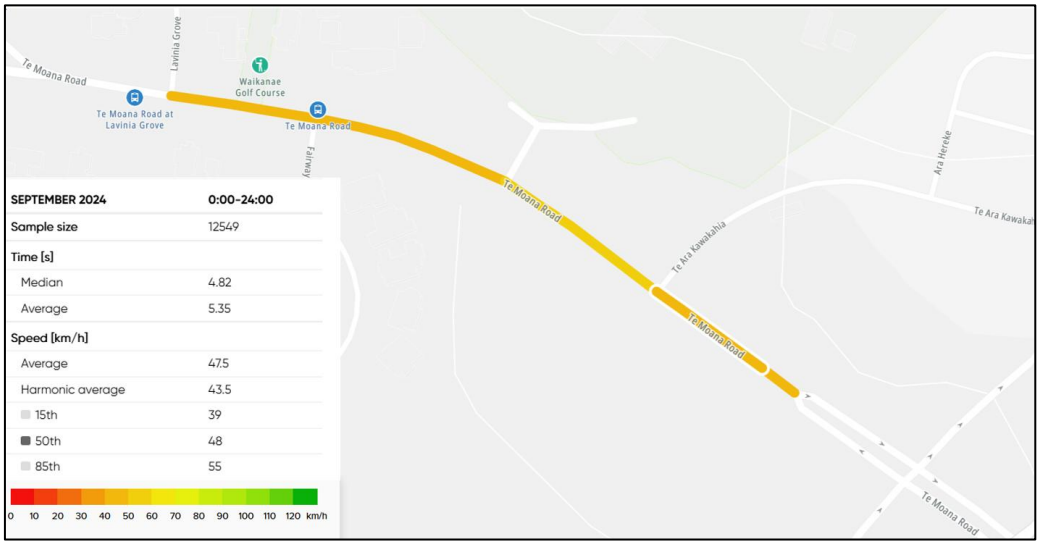


Figure 6 – Vehicle operating speeds on Te Moana Road.

3.4 Road Safety

A review of NZTA's crash analysis system (CAS) has been undertaken to understand the nature and severity of crashes that have occurred on Te Moana Road near the site over the past 5 years. The search area for Te Moana Road extends between Rauparaha Street and the Kapiti Expressway Interchange. This reveals there has been 12 reported crashes over this time period as shown in figure 6. Detail on each of the reported crashes including crash year, severity, location and description and are provided in table 1.

Crash Year	Severity	Location	Description
2023	Serious-Injury	Driveway just west of Te Ara Kawakahia intersection	Vehicle exiting driveway onto Te Moana Road crashed into cyclist travelling westbound on path.
2023	Minor-Injury	Golf Course vehicle crossing onto Te Moana Road	Vehicle exiting driveway failed to look left with cyclist crashing travelling westbound along path crashing in the vehicle.
2023	Non-Injury	Kapiti Expressway offramp to Te Moana Road	Vehicle travelling west after midnight turned the wrong way up the off-ramp crashing into traffic light pole.
2023	Non-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle making right turn from Te Moana Rd onto expressway on ramp failed to give way to vehicle approaching from the east. Error made due to confusion around filtered right turn.
2023	Non-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle travelling eastbound rear-ended vehicle stopped for red light.
2022	Non-Injury	Western approach to first set of traffic lights at Expressway Interchange.	Vehicle approaching from the west failed to stop for red light, crashing into rear of vehicle ahead.
2021	Non-Injury	Te Moana Road on eastern side of Expressway Interchange.	Vehicle travelling eastbound away from interchange crashed into rear of vehicle parked within road shoulder.
2021	Non-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle turned right from Te Moana Road onto Expressway on ramp from a standing start with vehicle losing control and crashing into traffic signal pole.

2020	Minor-Injury	Western approach to first set of traffic lights at Expressway Interchange.	Vehicle stopped on westbound side of Te Moana Road where driver got out to help a swan that had been hit by a vehicle. As driver has stood up, she has been struck by the wing mirror of a passing vehicle.
2020	Minor-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle has made a sudden right turn from Te Moana Rd onto expressway on ramp, vehicle has then rolled onto its roof. Note three passengers within tray of ute.
2020	Non-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle making right turn from Te Moana Rd onto expressway on ramp failed to give way to vehicle approaching from the east. Error made due to confusion around filtered right turn.
2020	Non-Injury	Expressway/Te Moana Rd interchange on ramp	Vehicle was stopped at red light westbound and following vehicle failed to stop and rear ended it.

Table 1 – 5-year crash history.

Figure 7 – Reported crashes near the proposed plan change site.

A review of the crash data shows that there have been two crashes involving vulnerable road users (one causing serious injuries) with two cyclists being struck by vehicles exiting driveways within 100 metres of each other along the northern side of Te Moana Road. The remaining reported crashes have all been centred around the interchange with several rear end type

crashes occurring between vehicles queueing as well as two very similar crashes involving right turn filtering from Te Moana Road onto the Kapiti Expressway on ramp.

Many of the crashes appear to have been caused by factors relating to driver behaviour including excessive speed, driving under the influence and distraction. Based on the crash data over the 5-year period, approximately 33% have been rear end type crashes on approach to the traffic lights followed by 17% of the crashes involving vulnerable road users and a failure by right turning vehicles to give way to approaching vehicles through the traffic lights.

Based on the reported crashes it is reasonable to conclude that there is some misunderstanding as to how right turn filtering works as well as potentially an issue with driver distraction where there is a concentration of rear end type crashes.

4 Sustainable Transport

4.1 Walking and Cycling

There is provision for pedestrians along the northern side of Te Moana Road with a concrete footpath extending along this side of the road, however there is no footpath along the southern side of the road and along the frontage of the site. There are limited crossing opportunities for pedestrians across Te Moana Road near the site with the nearest formal crossing being a dual pedestrian/cycle crossing on the eastern side of the expressway and an informal crossing near Fairway Oaks Drive.

In terms of cycling, there is an eastbound on road cycle lane that passes opposite the site with this formally commencing across the top of the intersection of Te Ara Kawakahia and extending through to the expressway interchange, while outside of this the road features a wide sealed road shoulder providing adequate room for cyclists where parking does not occur. Within 250 metres is the expressway shared path which extends north-south along the eastern side of the expressway, providing a safe facility north and south. Figure 7 provides information on the location of walking and cycling facilities relative to the site.

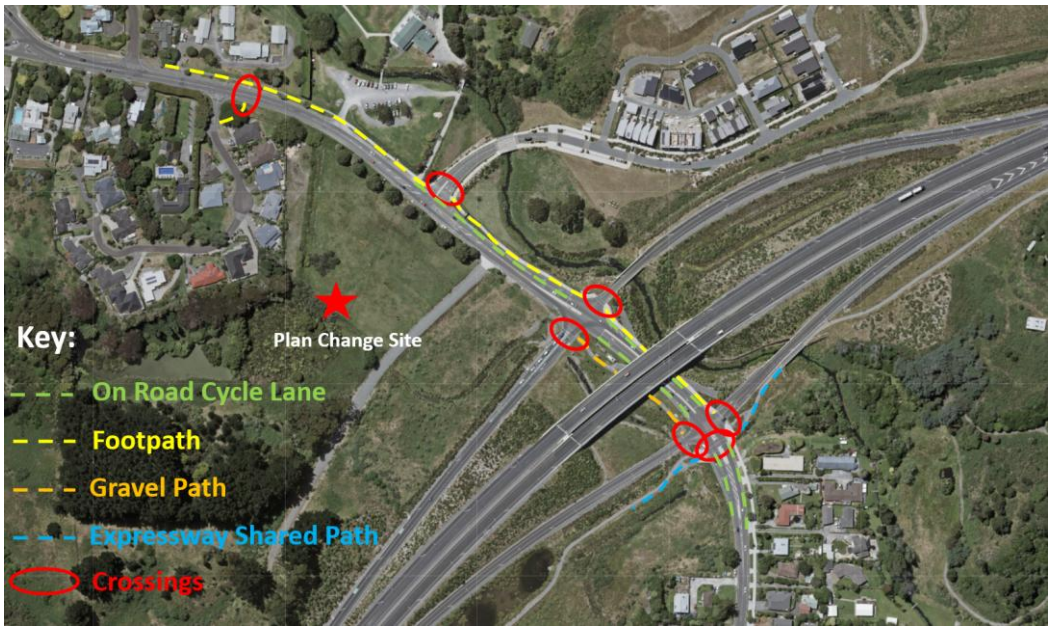


Figure 8 – Walking & Cycling Facilities near the site.

4.2 Public Transport

The proposed plan change site is considered to be well located in terms of proximity to public transport with the bus route 280 extending along Te Moana Road between the beach area, Town Centre and south through to Paraparaumu Station. The route 280 runs to a frequency of between of between 20 and 30 minutes throughout the day.

There are two bus stop pairs located within 350 metres the plan change site which is considered to be within a 5 -10 minute walk of the site. Bus services throughout Kapiti are operated by Metlink, as part of the Greater Wellington Regional Council. Within 3.5km is the Waikanae Railway Station where commuter rail services run frequently through the day into Wellington City. The bus route 280 connects through to the railway station and there are also large park & ride carparks located near the station.

Figure 9 – Bus Route 280 and proximity of bus stops to the site.

5 Other Enabled Sites

Directly opposite the proposed plan change site (on the northern side of Te Moana Road) is a large land holding (originally known as Ngarara farms) which was rezoned 15 years ago with an anticipated development yield of up to 900 dwellings. The block now sits within the Ngarara Development Area under the Kapiti Coast District Plan with development of this block to be guided by the Ngarara Development Area Structure Plan as shown in figure 10. As shown in the structure plan this zone is defined into several neighbourhoods with two of these (Waimeha & Ti Kouka) partially developed and or consented for future development with vehicle access provided back to Te Moana Road via Te Ara Kawakahia.

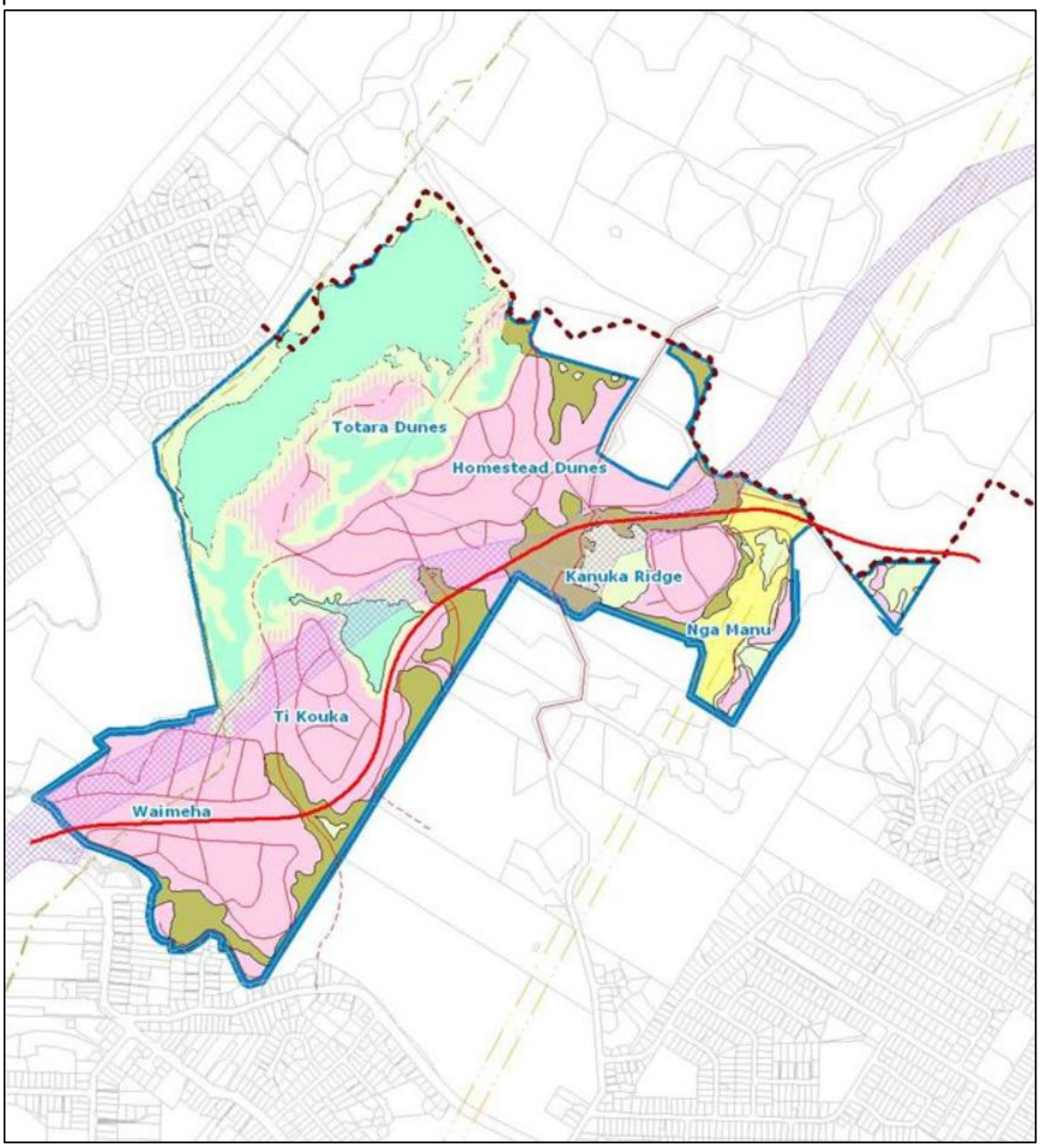


Figure 10 – Ngarara Development Area Structure Plan. Source – KCDC District Plan.

Through discussions with officers from Council's Access & Transport team there was a request that as part of the assessment of effects on the nearby expressway interchange, the potential future vehicle movements from the within the Ngarara Development Area needed to be considered before then applying the estimated number of future vehicle movements from the proposed plan change area onto the existing network and adjacent interchange.

As such, council officers provided the transport assessments that had been undertaken during the consenting process for the first two neighbourhoods. One of these reports completed by Jacobs Ltd "Ngarara Farm Development Integrated Transport Assessment – 18 December 2014" was used in defining the amount of vehicle movements that would likely utilise Te Ara Kawakahia and the adjacent expressway interchange via Te Moana Road.

In reviewing the Jacobs report and the structure plan there is intended to be a collector road which extends between Te Moana Road through to Ngarara Road with this to provide as the main access point for vehicles from the various neighbourhoods and the surrounding local road network. The construction of this road will require the Homestead block/neighbourhood to be consented before a connection can be provided through to Ngarara Road. This connection to Ngarara Road can be expected to reduce the number of vehicles that come and go from the development via Te Moana Road, particularly for local trips such as back towards the town centre.

For the purposes of this report, it has been agreed with council officers to apply the cumulative total of vehicle movements from the Waimeha, Ti Kouka & Homestead Neighbourhoods assuming a total yield of 900 dwellings for daily traffic generation of 9,017 vehicles and 578 and 744 vehicle movements during the AM and PM peak hours respectively. These figures were used during used by Jacobs during the consenting of the Waimeha neighbourhood.

6 The Proposed Plan Change

The applicant is seeking to re-zone the existing property at 100 and 110 Te Moana Road from Rural to Residential zoning. While the site is broken into two stages (stage 1 outside highly productive land & stage 2 being highly productive land), the rezoning is sought across the site as a whole. For the avoidance of doubt, if only Stage 1 were to proceed, the transport effects would be less or no different to what has been assessed for the site as a whole.

The layout of future subdivision of the site will be subject to separate consenting processes and the actual number of sections could vary depending on opportunities and constraints at that time. Future development of the site will be required to meet the requirements of the Kapiti Coast District Plan, noting that where the requirements of the District Plan cannot be met a resource consent will be required for any non-compliances.

The proposed development concept plan has a single access to Te Moana Road, with the development to provide new roads that are expected to be vested with council. Refer to figure 11 which shows the indicative development concept for the site.

Figure 11 – Proposed Structure Plan.

The maximum yield for the site would be around 50 sections, with the potential for 3 dwellings per section permitted under the provisions of the Medium Density Residential Standards (MDRS). From a transport perspective the permitted baseline of development is therefore assessed at 150 dwellings, with this used in assessing potential traffic generation, trip distribution and any other network implications that may need to be considered.

7 Assessment of Effects

This section of the report provides an assessment of the proposed plan change site with respect to potential traffic generation, trip distribution and the identification of any effects on Te Moana Road and the nearby interchange. The report also considers any potential effects with regard to road safety and sustainable transport including walking, cycling and public transport. This assessment also includes identification of any mitigations or measures which should be delivered now or at some point in the future (i.e. at the resource consent stage).

The following subheadings make up this assessment of traffic effects.

- Traffic Generation
- Trip Distribution & Effects
- Road Safety
- Sustainable Transport

It should be noted that this assessment looks at the impacts which will form the framework for future development of the plan change area. Appropriate analysis and assessment will be prepared as part of the future subdivision consents which will include an assessment of the traffic impacts, road layouts and any measures required to address any adverse effects.

7.1 Traffic Generation

The proposed plan change site has been assessed against the trip generation rates found in the RTA Guide to Traffic Generating Developments 2002. On the basis that the provisions of the medium density residential standards will apply to the site (whereby each future section could see up to 3 dwellings constructed by right), the plan change site could be expected to yield 150 dwellings in total.

Under section 3, table 3.7 of the RTA guide, each dwelling can be expected to generate 9 vehicle movements per day and 0.85 vehicle movements in peak hours. On this basis the proposed plan change site could generate up to 1,350 vehicle movements per day and up to 128 vehicle movements during peak hours.

Te Moana Road currently carries an estimated 10,002 vehicles per day with the plan change site expected to generate a 13.5% increase to daily traffic volumes over time. Under the ONF, a road with this classification would typically move in excess of 20,000 people per day across all modes including private vehicles, public transport, walking and cycling. Based on the New Zealand Household Travel Survey, dated March 2015, average vehicle occupancy within New Zealand is 1.51 people per vehicle which would suggest around 15,000 people are currently moved by vehicle on Te Moana Road, not accounting for those travelling by foot, by bike or on public transport.

The projected increase to traffic volumes would amount to approximately 17,142 people being moved by private vehicle with the rest by public transport, walking and cycling, which would suggest that the increase in traffic activity on Te Moana Road would be in line with its classification as a major community connector road.

7.2 Trip Distribution & Effects

On the basis that the proposed plan change site is estimated to generate 128 vehicle movements during peak hours, extensive modelling has been undertaken of the adjacent interchange using the modelling software SIDRA in order understand how the interchange will perform into the future. As detailed in section 4.3 of this report, consideration is also required regarding the peak hour traffic flows that will be generated from the Ngarara Development (referred to as Ngarara Farm in the modelling).

Four scenarios have been modelled in SIDRA of the nearby expressway interchange as follows with output results provided in attachment 1 covering network performance, levels of service, average queue lengths and average delay on each approach.

Scenario	**Additional Traffic Movements**
Existing Interchange + Ngarara Farm AM Peak	578 additional vehicle movements through Interchange
Existing Interchange + Ngarara Farm AM Peak	744 additional vehicle movements through Interchange
Existing Interchange + Ngarara Farm + Plan Change Site AM Peak	706 additional vehicle movements through Interchange
Existing Interchange + Ngarara Farm + Plan Change Site AM Peak	872 additional vehicle movements through Interchange

Commentary on SIDRA Model Outputs (detailed outputs provided in attachment 1)

1. Existing Interchange + Ngarara Farm AM Peak
   As shown in attachment 1, the interchange operates at a level of serve D with the SIDRA model prioritising the westbound movement along Te Moana Road in order to minimise delays on these two approaches. As such the cycle time is expected to increase to 140 seconds. Average queuing on the Te Moana Rd west approach will be significant and will result in the queue extending through the Te Ara Kawakahia intersection for a period of time.

   As a result of the prioritised Te Moana Road movement, vehicles on the two off-ramps from the expressway will experience significantly greater delays than they experience currently.

   Due to the single lane approaches on the Te Moana Road approaches to the intersection, this has a direct impact on the length of some of queuing.

2. Existing Interchange + Ngarara Farm PM Peak
   As shown in attachment 1, the interchange operates at a level of serve D. The cycle time will be 90 seconds. Low levels of delay are expected on the Te Moana Rd east approach to the interchange, noting that in the model this approach carries a significant number of the vehicle movements during the evening peak.

   As shown in attachment 1, the westbound midblock section within the interchange queue is close to reaching capacity, while the other dominant movement being the left turn from the northbound expressway off ramp to Te Moana Road will be beyond capacity. While the offramp is ~400m long, the left turn lane is only around 80m long hence the capacity issue here.

3. Existing Interchange + Ngarara Farm + Plan Change Site AM Peak
   As shown in attachment 1, the interchange will continue to operate at a level of service D. The cycle time will run at 140 seconds with average delays managed through the interchange where possible, particularly midblock eastbound on Te Moana Road where the queuing will not have the chance to extend beyond the block.

   The proposed location of the main intersection to the plan change site will be located around 70m west of the interchange with the eastbound queue to extend further west through the Te Ara Kawakahia intersection for a period of time. This will result in quite a long queue forming within the plan change site. A two-lane approach has been shown exiting the plan change site – this is unlikely and instead be of a lane width which allows a left turning vehicle to exit onto Te Moana Road while a right turning vehicle is also at the hold line.

   During the AM peak, arrival flows to the interchange will be constrained due to the queuing effects to the west.

4. Existing Interchange + Ngarara Farm + Plan Change Site PM Peak
   As shown in attachment 1, the performance of the interchange will drop to a level of serve E with this driven by delays through the midblock section of the interchange and resultant queuing effects back east along Te Moana Road.

   As a result of the heavy demand coming off the expressway, and constrained left turn lane onto Te Moana Road the level of service on this approach does reduce. The effects of this are a queue extending slightly further up the off ramp.

As shown in attachment 1, the performance and capacity of the interchange does reduce under the different traffic demand scenarios, particularly during the PM peak period when including the proposed plan change site. It is however noted that the interchange under each of the scenarios does not reach a level of service F, while there is no network change in the level of service during the AM Peak scenarios between that of the Ngarara Development Area traffic flows and the additional flows from the proposed plan change site.

The following factors are also considered to reduce level of service effects on the future performance of the interchange, where the modelling has otherwise been based on a worst-case scenario:

- Completion of collector road through Ngarara Development Area.

While it is reasonable to expect all development traffic from the neighbourhoods of Waimeha & Ti Kouka to access Te Moana Road over the near term, at such time that the Homestead neighbourhood is consented and developed this will result in the connector road (as defined in the structure plan) being constructed. At this time, it is reasonable to expect a more even distribution of traffic flows across the local road network where road users will not be restricted to using only Te Moana Road. This can be expected to result in a reduction of traffic flows through the expressway interchange.

- Timing of Resource Consents

While the Ngarara Development Area has been enabled for residential development, resource consents are still required to develop each neighbourhood. Given the size of the Ngarara Development Area, it is perfectly reasonable that should this proposed plan change be approved, resource consents may be lodged with council before significant future development is consented within the Ngarara Development Area. Cumulative traffic effects are considered in closer detail during the resource consent process, so the timing of such consents will determine what if any mitigations are required at the interchange.

- Scale of Development

The modelling undertaken assumes a maximum housing yield of 3 dwellings per lot. Should the proposed plan change be approved, future development of site may result in a reduced yield being provided. This will have a direct correlation to the amount of additional traffic movements that are introduced onto Te Moana Road. This may result in a situation where the outputs of the interchange modelling are overstated.

Overall, it is assessed that should the proposed plan change be approved this will result in an increase of vehicle movements on Te Moana Road as well as through the nearby interchange. The intersection modelling undertaken assumes that all of the future development traffic from the Ngarara Development Area will utilise Te Moana Road and as a result the expressway interchange as well before any development occurs at the proposed plan change site.

As assessed within this section of the report there are several factors that are likely to reduce the capacity and performance impacts at the interchange over time, nevertheless while there will be a degradation of the performance of the interchange, additional traffic flows can be accommodated albeit with increased delays at peak times. It is anticipated that should the plan change be approved; more detailed analysis will be required of the interchange at such time that resource consents are being sought.

7.3 Road Safety

As detailed in section 3.4 of this report, of the 12 reported crashes within the vicinity of the plan change site, 33% have been rear end type crashes involving vehicles approaching the interchange, followed by 17% of crashes involving vulnerable road users, specifically cyclists as well as crashes involving filtered right turns at the interchange.

It is evident that there is an existing issue of drivers not maintaining a safe following distance to the vehicles ahead of them, as well as potentially a lack of understanding as to how right turn filtering works at signalised intersections. Given the dominance of these crash types within the crash data, it is reasonable to expect that any increase in traffic volumes could increase the risk of these crashes occurring.

It needs to be recognised that the rear end type and right turn filtering crashes at the interchange are less to do with any engineering deficiencies and more so to do with driver behaviour and understanding of the road rules. Given this is an existing issue which cannot be influenced by the proposed plan change, council may wish to understand if these crash types are also prevalent at other signalised intersections across the district and respond by running road safety advertising campaigns that seek to improve driver education and behaviour in these situations. Such activities would be consistent with councils existing road safety promotion work across the district.

Where there have been two crashes involving cyclists near the plan change site in the past, future subdivision of the site can be expected to better cater for these road users as there is already informal provision for cyclists along the southern side of Te Moana Road. The future design and construction of an intersection to the plan change site would need to consider all road users including legitimising the presence of cyclists in this location. This is expected to be positive in providing an on-road cycle facility that better caters to potential areas of conflict than existing (cyclists on the footpath).

7.4 Sustainable Transport

- ### Walking & Cycling

As mentioned in section 4.1 of this report there is a continuous footpath along the northern side of Te Moana Road past the plan change site with connectivity provided across side roads along with several signalised crossings at the interchange. There is however no existing footpath along the southern side of the Te Moana Road fronting the plan change site.

The future subdivision of the plan change site is likely to result in the creation of public roads and footpaths within the site, resulting in demand for pedestrians to get across Te Moana Road as well as back east towards the interchange. Recognising that future subdivision of the plan change site will result in the need for a new intersection to be designed and constructed fronting Te Moana Road, there may be insufficient space to provide a pedestrian crossing between the future new intersection and that of Te Ara Kawakahia resulting in the need to extend a footpath further west along the southern side of Te Moana Road to a position where a pedestrian crossing facility could be constructed. The extent of potential future footpaths and crossing locations is indicatively shown in figure 12.

In terms of connectivity of plan change site to the surrounding network for cyclists it can be expected that the legibility of the westbound on road cycle lane past the front of the plan change site will improve whereby any future intersection would need to incorporate the presence of these road users both across the future intersection and on its approach and departure sides.

Accessibility to the surrounding network would also be expected to improve where cyclists will benefit from a crossing being located on Te Moana Road as well as a pathway back east towards the expressway interchange and onwards to the expressway shared path.

- Public Transport

As identified earlier in this report, Te Moana Road forms part of a relatively frequent bus route past the proposed plan change site, with two bus stop pairs located within 200 metres to the east and west.

Future subdivision of the site can be expected to contribute positively to accessibility for customers walking to and from these bus stops with new sections of formed footpath and the ability to cross Te Moana Road to be made easier for bus users.

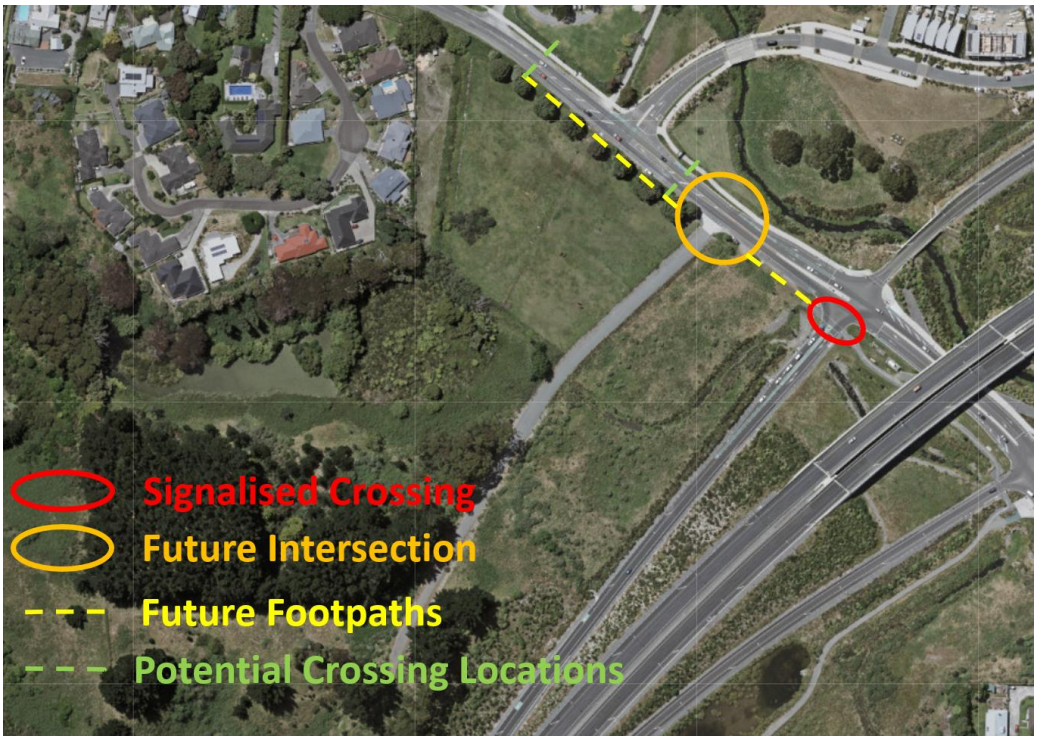


Figure 12 – Future pedestrian connectivity from the plan change site.

8 Strategic Alignment

This section of the report considers the proposed plan change site and its alignment against the following strategic documents, plans and strategies within the context of the proposed rezoning in regard to transport.

- Objectives & Policies of the Transport Chapter of the Kapiti Coast District Plan (2021)
- Kapiti Coast District Council Sustainable Transport Strategy (2022)

8.1 Kapiti Coast District Plan - Transport Chapter (2021)

The transport chapter of the operative district plan contains a number of objectives and policies that are considered to be relevant to the plan change site. In terms of access and transport the objectives under DO-014 are listed below:

DO-O14 – Access and Transport.

To ensure that the transport system in the district:

1. Integrates with land use and urban form and maximises accessibility;
2. Improves the efficiency of travel and maximises mode choice to enable people to act sustainably as well as improving the resilience and health of communities;
3. Contributes to a strong economy;
4. Avoids, remedies or mitigates adverse effects on land uses;
5. Does not have its function and operation unreasonably compromised by other activities;
6. Is safe, fit for purpose, cost effective and provides good connectivity for all communities; and
7. Provides for the integrated movement of people, goods and services.

Comment:

With regard to the objectives listed above, the plan change site is located such that it will integrate with existing residential land uses within its immediate vicinity while maximising mode choice where walking, cycling and access to public transport will be enhanced through future subdivision of the site. Future development of the plan change site will enable measures to be introduced within the immediate road network that will mitigate any adverse effects for road users (both existing and new). Future development of the plan change site is also expected to integrate safely with the existing transport network where the resource consenting process and councils own district plan rules and standards will support this objective.

The following are considered to be the relevant policies within the transport chapter of the district plan with commentary provided beneath each as to the alignment of these policies in respect to the plan change site.

TR-P1 integrated Transport & Urban Form

Development and subdivision will be integrated with and consistent with the transport network hierarchy in TR-Table 7 and undertaken in a manner and at a rate to ensure:

1. The transport network is capable of serving the projected demand safely and efficiently;

2. The location of development is appropriate, including providing for the co-location of compatible developments and land use and transport networks to reduce unnecessary travel;
3. Travel time and distance to services are minimised for all modes of transport;
4. Development is consistent with council's land development minimum requirements; and
5. Enhanced community connectivity is achieved, resulting in more efficient travel patterns from the community.

Comment:

The plan change site is located directly adjacent to an already established urban area and within an area where significant greenfield development is occurring with the immediate transport network able to service the additional demand in trips expected to be generated by the plan change site.

To enable the plan change to proceed will ensure travel time and distances to services and facilities are within the realm of what people already living within the area experience day to day. This would not be achieved should the plan change not proceed and the equivalent level of development were to occur further afield.

TR-P2 Sustainable Transport and Maximising Mode Choice

Development and subdivision will be integrated with a transport system that offers a wide range of travel mode choices, which connects residents to essential community services, centres, and social infrastructure, through;

1. Well integrated and connected communities;
2. Development that is conductive to active modes of travel, particularly walkable communities which reduce demand for vehicular travel, particularly by private vehicle;
3. Land use that is integrated with the transport network;
4. Improved public transport services to the district;
5. Travel plans and transport assessments for major traffic activities as part of an application for consent for new developments;
6. Consistency with the council's land development minimum requirements; and
7. Development that ensures adequate access and space for all modes, including pedestrians, people with mobility problems, cyclists, public transport and private car travel.

Comment:

The plan change site is located such that it affords the opportunity to integrate into the existing transport network where all modes of transport are provided for. There is the opportunity for access to sustainable transport modes including walking, cycling and public transport to be fully enabled and enhanced through infrastructure enhancements that will be required during future subdivision of the site.

It should be noted that future land use consenting for the plan change site would enable any effects to be more well defined and the appropriate mitigations to be considered and agreed in line with the rules of the transport chapter of the district plan.

TR-P3 An Efficient and Economic Transport Network

The development, operation, maintenance and upgrading of the transport network will increase the economic vitality of the district by:

1. Promoting reliable access to basic social, civic and day to day services (such as health services, schools and local shopping facilities) consistent with the transport network hierarchy maps, district plan maps;
2. Promoting timely and reliable access of freight and goods for processing and markets, without compromising the amenity of living and other sensitive activities; and
3. Promoting reliable access of workers to employment, with a priority placed on local employment access but a recognition of links with regional employment.

Comment:

Should the plan change be granted, future land use consenting processes applicable to the site can be expected to give due consideration to the detailed transport effects (if any) while giving effect to the above policies.

Future development of the plan site will be consistent with regard to the transport network hierarchy where the strategic importance of Te Moana Road will be maintained in terms of the movement of vehicles, public transport and walking and cycling as well as continuing to be a key route for access to day to services and employment.

TR-P5 Effects of Transport on Land Use on Transport

The potential adverse effects on the transport network from development and subdivision will be avoided, remedied or mitigated be identifying both the key existing transport routes and proposed transport routes likely to be required long term as part of the districts transport network and having regard to these when considering applications for subdivision or development.

Comment:

Should the plan change be granted, the future land use consenting processes for the development of the site will enable the required transport assessments to take place. These assessments will be key in identifying any adverse effects on the transport network and would typically identify appropriate mitigations.

For instance, where appropriate measures and mitigations have been identified through this transport assessment (improved pedestrian connections), it is expected that the detail around these will be assessed and further refined as a means to address effects for pedestrians, cyclists and access to public transport.

TR-P6 Safety

The safety of all transport users will be enhanced during the development, operation, maintenance and upgrading of the transport network by:

1. Implementing the principles set out in appendix 6 – CPTED guidelines

2. Requiring that all developments provide for safe vehicular and pedestrian access, and have adequate visibility (sight lines);
3. Requiring all developments to have safe connections to the wider transport network; and
4. Requiring adequate visibility and sightlines for level crossings.

Comment:

The transport assessment that has been undertaken to assess the proposed plan change has considered the safety performance of the existing road network (in particular Te Moana Rd and the nearby expressway interchange in order to understand the type, severity and causes of crashes that have occurred in the past.

Should the plan change be granted, future land use consenting processes for the site will enable the required transport assessments to be carried out. Such assessments at the resource consent stage would likely include preliminary design work of transport links internal and external to the site. This would typically involve road safety audits as required by the district plan to be completed that would identify any safety issues within the design which need to be resolved, giving direct effect to above policies.

TR-P7 Cycling, Walking and Bridleway Links and Safety

Subdivision, use and development will be as far as practicable, located and designed to make walking, cycling and use of bridleways safer, more enjoyable and convenient in accordance with CPTED guidelines and the following principles:

1. New street linkages will provide safe pedestrian access to shops and services and public transport nodes;
2. Subdivision and development will:
    a. Enable cycle and pedestrian routes, both on and off road, which offer good continuity;
    b. Avoid large blocks the severe connectivity; and
    c. Consider opportunities to provide bridleways in suitable locations; and
3. Development will provide for convenient cycle parking facilities in centres; and
4. Pedestrian and cycle routes will have well designed and built facilities including surface conditions, lighting, signage, and passive surveillance from adjacent development.

Comment:

The transport assessment completed for this plan change has identified the need to provide pedestrian connectivity between the plan change site and interchange as well as provide a new pedestrian crossing facility across Te Moana Road in order to improve and provide a safe way for people to access public transport. The identification of these measures will also have benefits for cyclist if implemented.

Future land use consenting of the site should the plan change be granted will allow these infrastructure improvements to be developed further and designed in order to deliver the intended benefits for pedestrians, cyclists and people accessing public transport.

8.2 Kapiti Coast District Council – Sustainable Transport Strategy (2022)

The Kapiti Coast District Council Sustainable Transport Strategy was developed and endorsed in 2022 and provides a framework for delivering sustainable transport outcomes across the Kapiti Coast District over the coming years.

This strategy outlines eight key focus areas that Council have identified and in which private development can contribute towards achieving outcomes within the district. Of the eight focus areas the following two are considered to be the most relevant to the plan change site and where future subdivision of the site is able to align with.

1. **Focus Area 1 – Improved connections and mode choice.**

   Council aims to enhance community connectedness through the creation of a well-planned physical transport system that allows for the reliable, efficient, and safe movement of people and goods. Decisions on allocation of space within the road corridor can assist with mode shift, relieve congestion, and improve access to services and economic opportunities, as well as supporting the health of our communities.

   Comment:
   Future subdivision of the plan change site will result in the need for improvements within the road corridor to enhance accessibility and improve connections for pedestrians and cyclists, which can be expected to contribute positively to councils' mode shift goals.

2. **Focus Area 2 – Integrating Land Use & Transport**

   When considering the need to travel and travel patterns, the relationship between land use and transport is fundamental one. Land use can affect travel patterns, particularly if alternatives to the private car are unviable, and the ability to travel somewhere easily and access goods and services can impact on decisions to locate new development.

   Comment:
   The plan change site is adjacent to an established part of the transport network, including provision for pedestrians, cyclists and public transport. Future development of the plan change site can be expected to contribute positively to enhancing existing facilities for these road users and in turn make it easier for existing and new trips to be made by these modes.

   Proximity of the plan change site directly adjacent to the Kapiti Expressway and nearby interchange, will mean that vehicle trips beyond Waikanae (i.e. where the expressway is used) can occur while limiting safety and efficiency impacts on the local road network.

9 Summary & Conclusions

This report has been prepared as part of an application for a private plan change to the Kapiti Coast District Council at 100 and 110 Te Moana Road, Waikanae. The proposed private plan change seeks to rezone the existing site from rural to general residential, allowing for increased density through future development of the site. A detailed transport assessment has been completed which has incorporated a review of the existing transport environment, incorporating Te Moana Road, Kapiti Expressway interchange, traffic volumes, speeds, road safety performance and existing provision of sustainable transport modes.

The assessment has included a full assessment of transport effects within the context of the plan change being granted and future residential subdivision occurring. This assessment has determined that vehicle traffic from future development of the plan change site is able to be accommodated within the existing road network including nearby expressway interchange, albeit resulting in increased delays and queuing during peak periods.

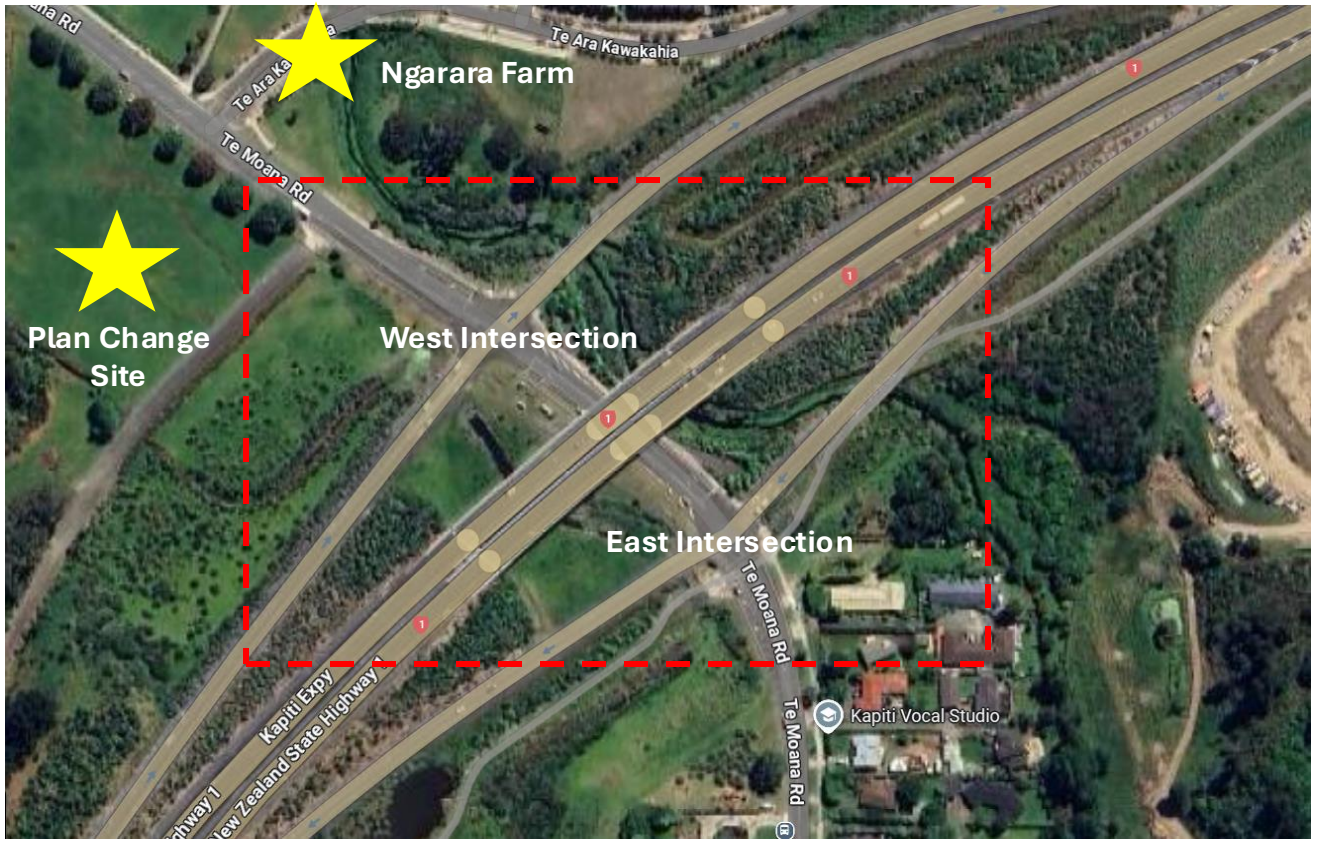
This assessment has also identified the need to provide a future pedestrian connection between the plan change site and the expressway interchange as well as a pedestrian crossing facility between the southern and northern sides of Te Moana Road. These measures have been identified as there is currently a lack pedestrian connectivity along the southern side of Te Moana Road, where future development of the plan change site can be expected to generate a level of pedestrian demand.

It is therefore assessed that the proposed plan change is able to supported from a transport perspective, with mitigations identified to improve accessibility and connectivity for pedestrians to and from the site as part of future subdivision of the site.

Attachment 1 - Expressway Interchange Modelling Outputs

SH1/Te Moana Rd Interchange Modelling – Proposed Private Plan Change

- Existing Interchange (AM & PM Peaks)
- Existing Interchange + Ngarara Farm (AM & PM Peaks)
- Existing + Interchange + Ngarara Farm + Plan Change Site (AM & PM Peaks)



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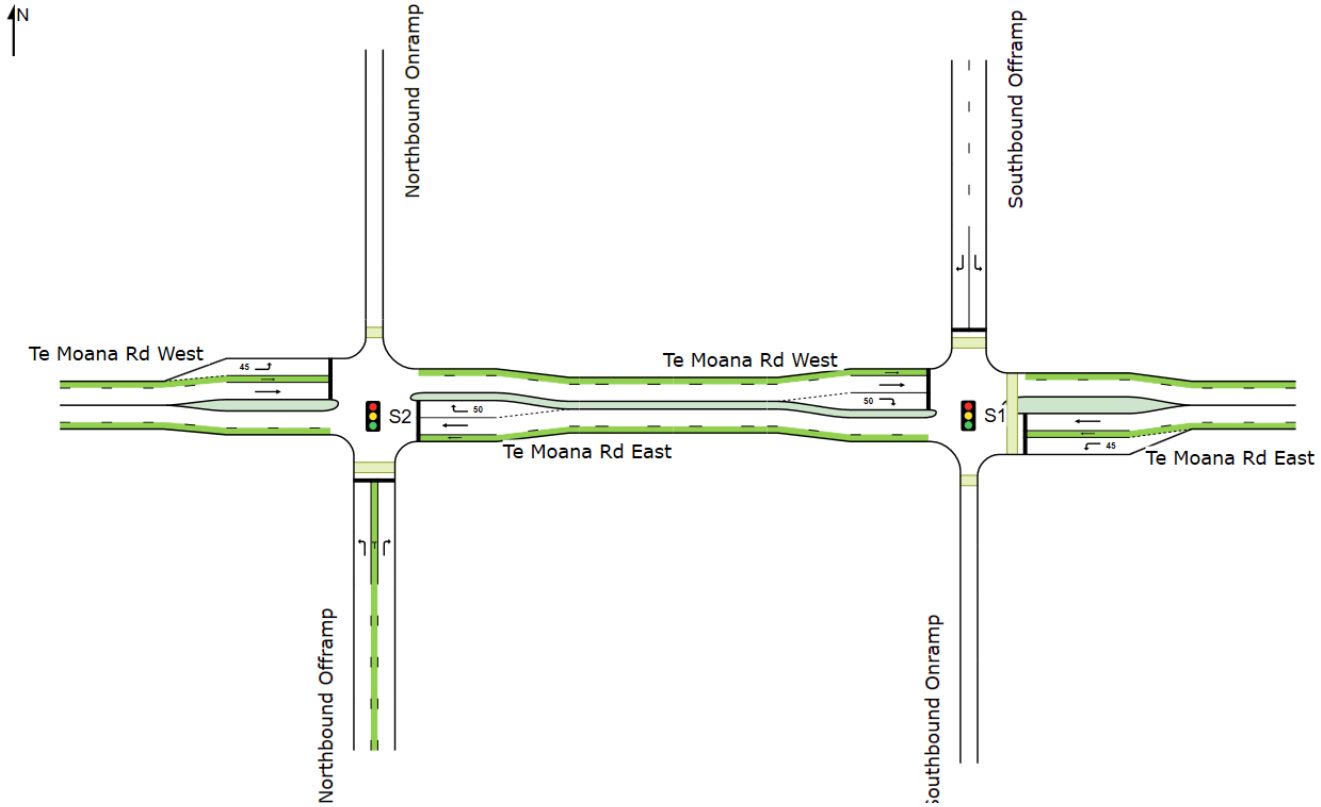
Existing Interchange AM & PM Peaks :

- Interchange input volumes provided by WTOC (Wellington Traffic Operations Centre) for the 16th September 2024.
- Input phasing provided by WTOC
- AM Peak (8am - 9am)
- PM Peak (4:30pm - 5:30pm)
- 6% heavies applied to all movements
- Correct geometry including lane lengths, widths etc. applied to all legs of interchange



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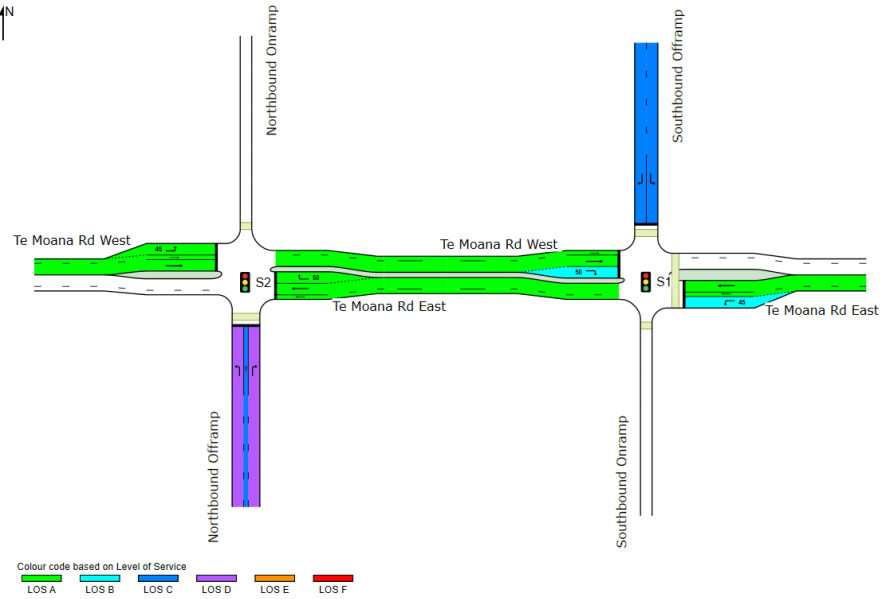
Existing Interchange AM Peak Results:

Network Performance

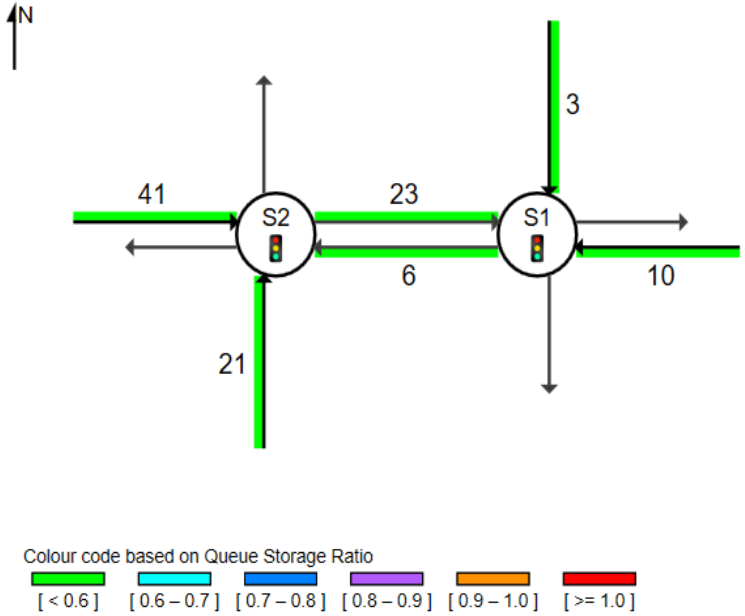
Network Cycle Time = 80.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated Sites
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS D
Speed Efficiency		0.59
Travel Time Index		5.49
Congestion Coefficient		1.68
Travel Speed (Average)	km/h	30.9
Travel Distance (Total)	veh-km/h	814.1
Travel Time (Total)	veh-h/h	26.4
Desired Speed	km/h	51.9
Demand Flows (Total for all Sites)	veh/h	1929
Arrival Flows (Total for all Sites)	veh/h	1929
Demand Flows (Entry Total)	veh/h	1105
Midblock Inflows (Total)	veh/h	4
Midblock Outflows (Total)	veh/h	0
Percent Heavy Vehicles (Demand)	%	5.6
Percent Heavy Vehicles (Arrival)	%	5.6
Degree of Saturation		0.435
Control Delay (Total)	veh-h/h	6.31
Control Delay (Average)	sec	11.8
Control Delay (Worst Lane by MC)	sec	37.8
Control Delay (Worst Movement by MC)	sec	37.8
Geometric Delay (Average)	sec	2.2
Stop-Line Delay (Average)	sec	9.5
Ave. Que Storage Ratio (Worst Lane)		0.33
Effective Stops (Total)	veh/h	1016
Effective Stop Rate		0.53
Proportion Queued		0.49
Performance Index		70.5

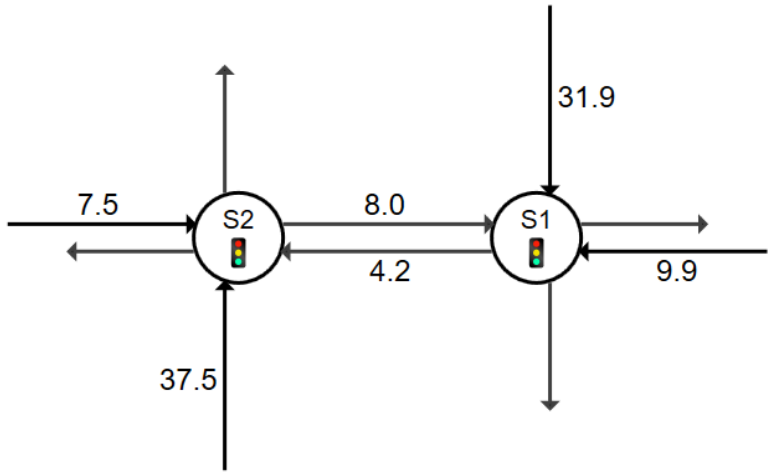
Lane LOS



Average Queue (m)



Average Delay (s)



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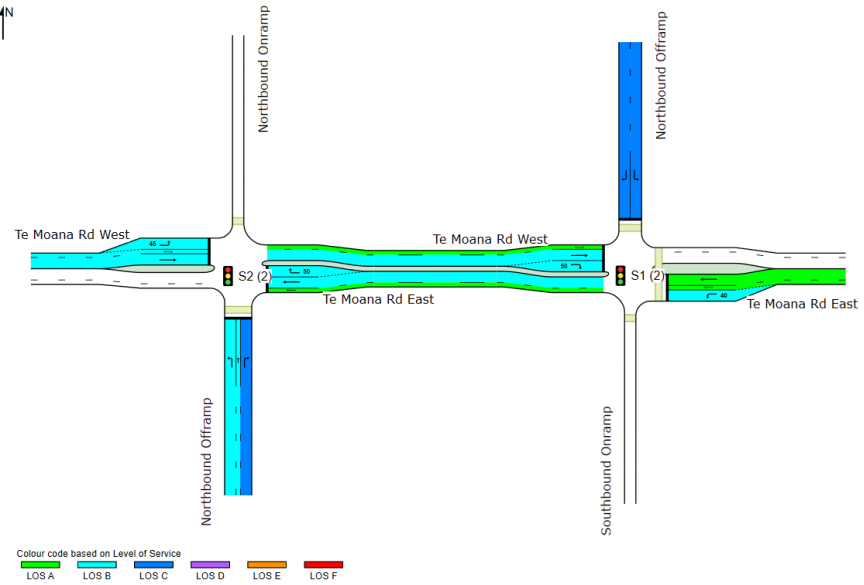
Existing Interchange PM Peak Results :

Network Performance

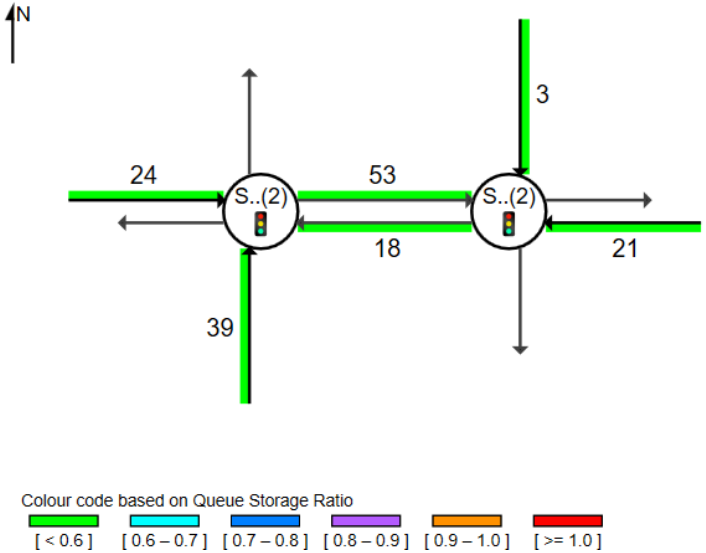
Network Cycle Time = 80.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated Sites)
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS D
Speed Efficiency		0.59
Travel Time Index		5.39
Congestion Coefficient		1.71
Travel Speed (Average)	km/h	30.9
Travel Distance (Total)	veh-km/h	1011.5
Travel Time (Total)	veh-h/h	32.7
Desired Speed	km/h	52.8
Demand Flows (Total for all Sites)	veh/h	2100
Arrival Flows (Total for all Sites)	veh/h	2100
Demand Flows (Entry Total)	veh/h	1305
Midblock Inflows (Total)	veh/h	12
Midblock Outflows (Total)	veh/h	-1
Percent Heavy Vehicles (Demand)	%	5.6
Percent Heavy Vehicles (Arrival)	%	5.6
Degree of Saturation		0.414
Control Delay (Total)	veh-h/h	8.98
Control Delay (Average)	sec	15.4
Control Delay (Worst Lane by MC)	sec	31.9
Control Delay (Worst Movement by MC)	sec	31.9
Geometric Delay (Average)	sec	2.7
Stop-Line Delay (Average)	sec	12.7
Ave. Que Storage Ratio (Worst Lane)		0.53
Effective Stops (Total)	veh/h	1299
Effective Stop Rate		0.62
Proportion Queued		0.63
Performance Index		94.3

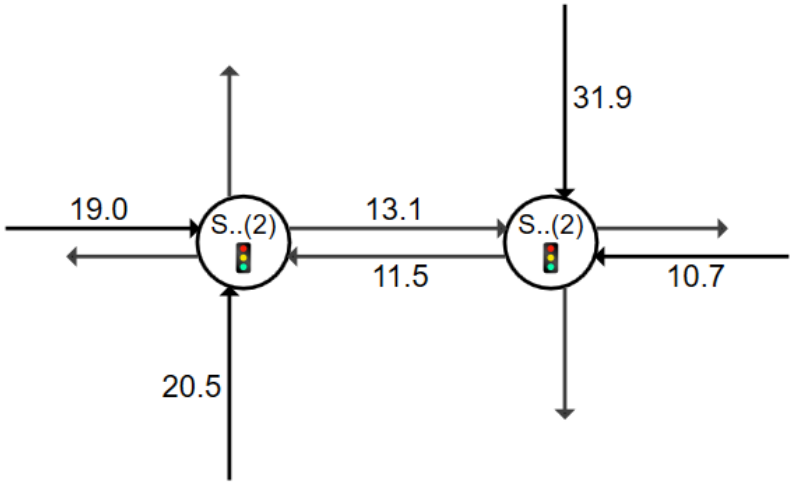
Lane LOS



Average Queue (m)



Average Delay (s)



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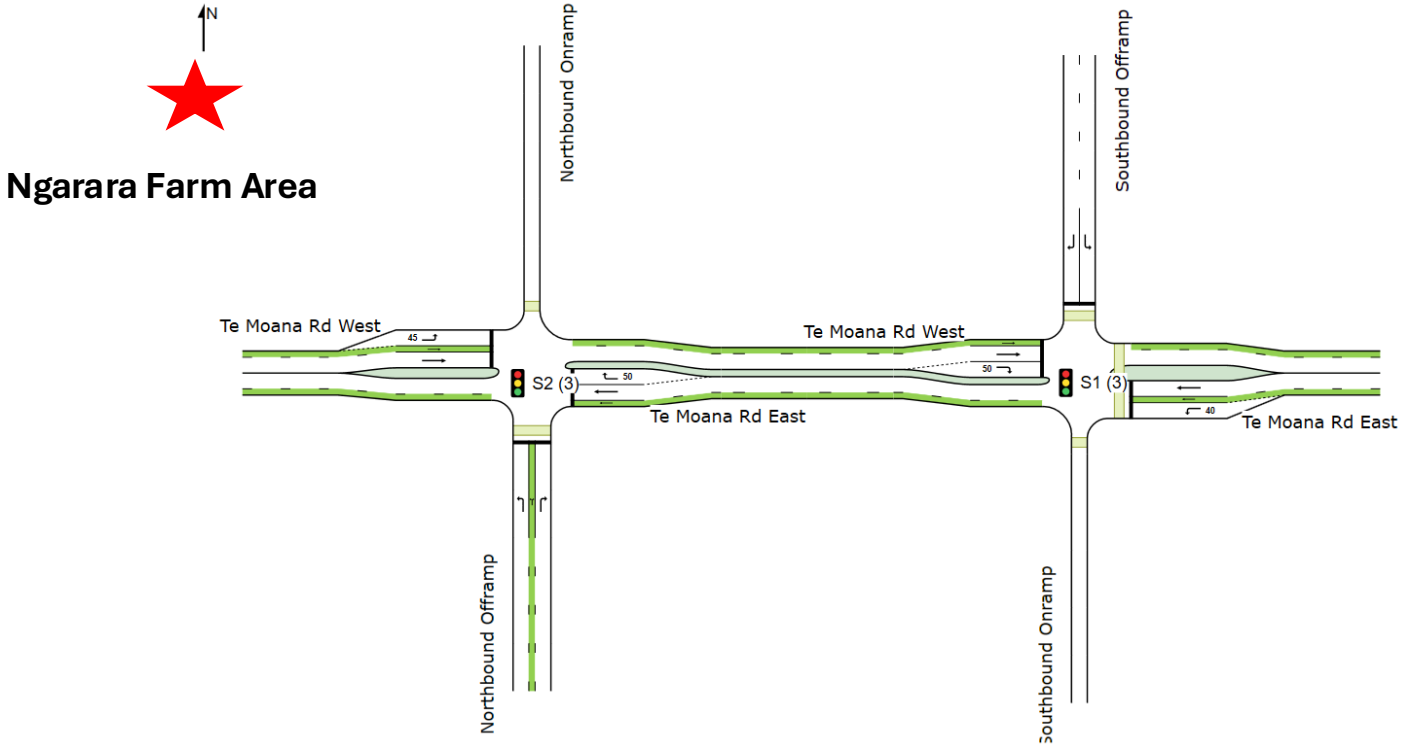
Existing Interchange + Ngarara Farm AM & PM Peaks:

- Interchange input volumes provided by WTOC (Wellington Traffic Operations Centre) for the 16th September 2024.
- Additional traffic volumes from Ngarara Farm Plan Change Area (enabled for development) as agreed with council (AM peak: + 578 vehicles & PM peak + 744 vehicles)
- Input phasing same as existing interchange
- AM Peak (8am - 9am)
- PM Peak (4:30pm - 5:30pm)
- 6% heavies applied to all movements
- Correct geometry including lane lengths, widths etc. applied to all legs of interchange



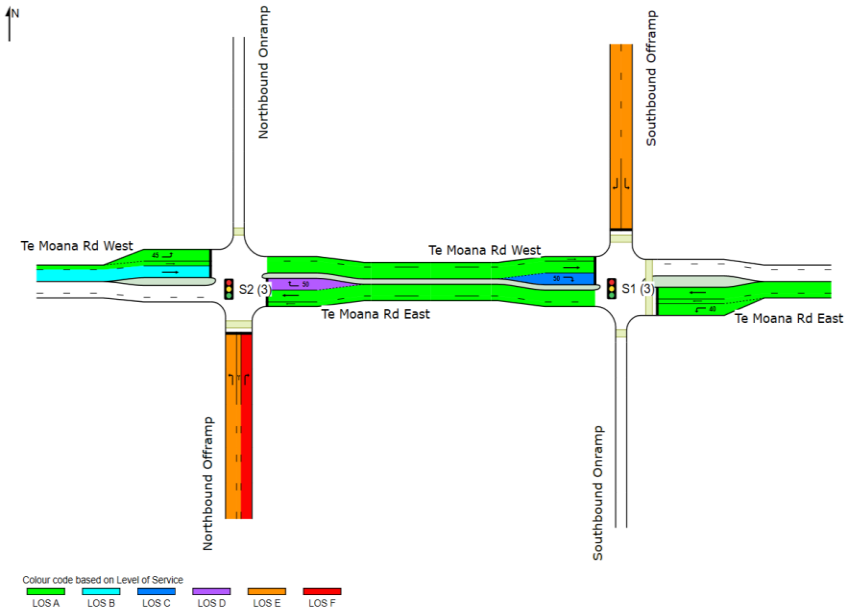
Existing Interchange + Ngarara Farm AM Peak Results :

Network Performance

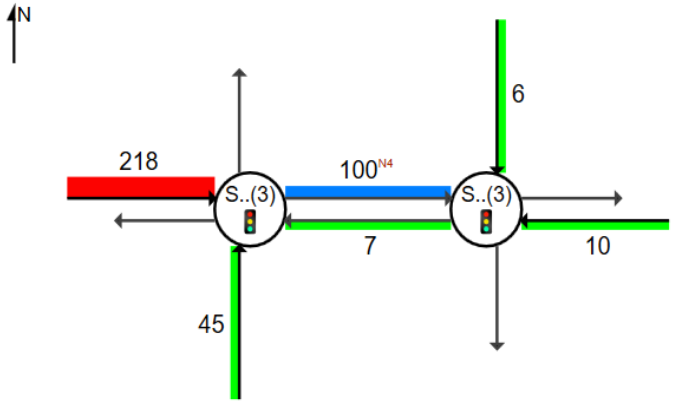
Network Cycle Time = 140.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated Sites):
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS D
Speed Efficiency		0.56
Travel Time Index		5.10
Congestion Coefficient		1.79
Travel Speed (Average)	km/h	28.9
Travel Distance (Total)	veh-km/h	1220.9
Travel Time (Total)	veh-h/h	42.2
Desired Speed	km/h	51.7
Demand Flows (Total for all Sites)	veh/h	3095
Arrival Flows (Total for all Sites)	veh/h	3095
Demand Flows (Entry Total)	veh/h	1723
Midblock Inflows (Total)	veh/h	0
Midblock Outflows (Total)	veh/h	-27
Percent Heavy Vehicles (Demand)	%	5.6
Percent Heavy Vehicles (Arrival)	%	5.6
Degree of Saturation		0.876
Control Delay (Total)	veh-h/h	14.70
Control Delay (Average)	sec	17.1
Control Delay (Worst Lane by MC)	sec	85.4
Control Delay (Worst Movement by MC)	sec	85.4
Geometric Delay (Average)	sec	2.0
Stop-Line Delay (Average)	sec	15.1
Ave. Que Storage Ratio (Worst Lane)		1.75
Effective Stops (Total)	veh/h	1929
Effective Stop Rate		0.62
Proportion Queued		0.56
Performance Index		188.7

Lane LOS



Average Queue (m)



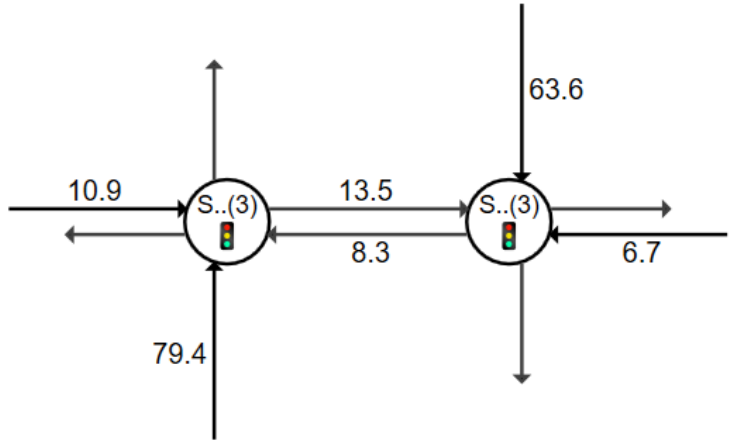
Colour code based on Queue Storage Ratio

[< 0.6] [0.6 – 0.7] [0.7 – 0.8] [0.8 – 0.9] [0.9 – 1.0] [>= 1.0]

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

N4 Average Back of Queue has been restricted to the available queue storage space as it extends to lanes at upstream Sites.

Average Delay (s)



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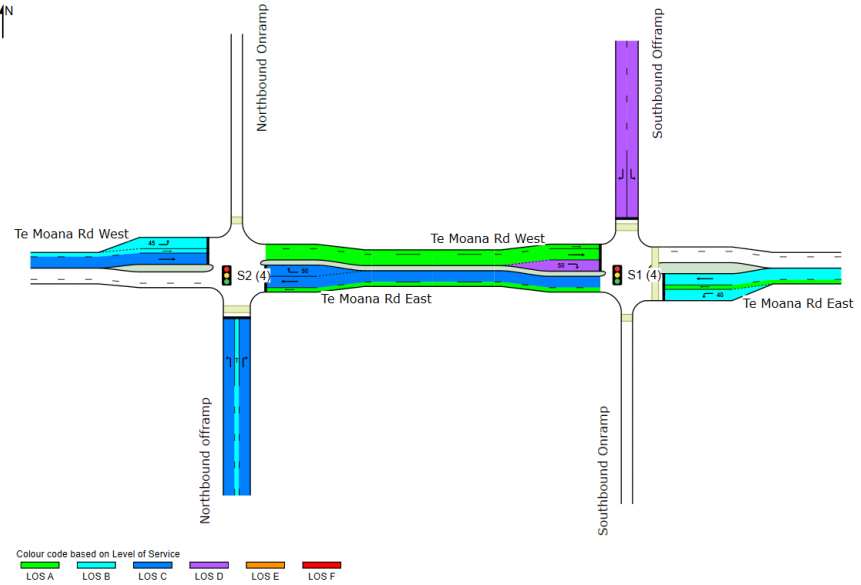
Existing Interchange + Ngarara Farm PM Peak Results :

Network Performance

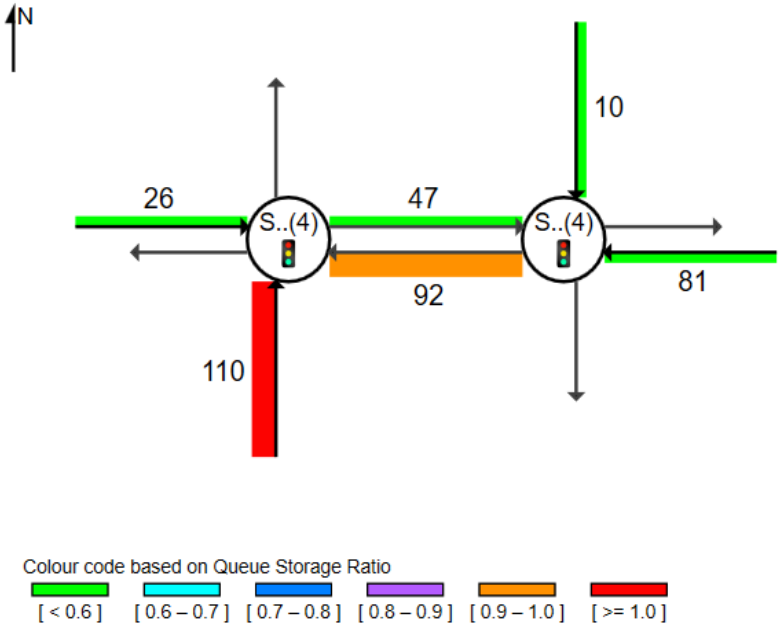
Network Cycle Time = 90.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated Sites):
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS D
Speed Efficiency		0.55
Travel Time Index		4.95
Congestion Coefficient		1.83
Travel Speed (Average)	km/h	29.0
Travel Distance (Total)	veh-km/h	1463.6
Travel Time (Total)	veh-h/h	50.4
Desired Speed	km/h	53.3
Demand Flows (Total for all Sites)	veh/h	3175
Arrival Flows (Total for all Sites)	veh/h	3175
Demand Flows (Entry Total)	veh/h	1994
Midblock Inflows (Total)	veh/h	12
Midblock Outflows (Total)	veh/h	-1
Percent Heavy Vehicles (Demand)	%	5.9
Percent Heavy Vehicles (Arrival)	%	5.9
Degree of Saturation		0.780
Control Delay (Total)	veh-h/h	18.70
Control Delay (Average)	sec	21.2
Control Delay (Worst Lane by MC)	sec	39.9
Control Delay (Worst Movement by MC)	sec	39.9
Geometric Delay (Average)	sec	2.5
Stop-Line Delay (Average)	sec	18.7
Ave. Que Storage Ratio (Worst Lane)		1.29
Effective Stops (Total)	veh/h	2294
Effective Stop Rate		0.72
Proportion Queued		0.74
Performance Index		180.4

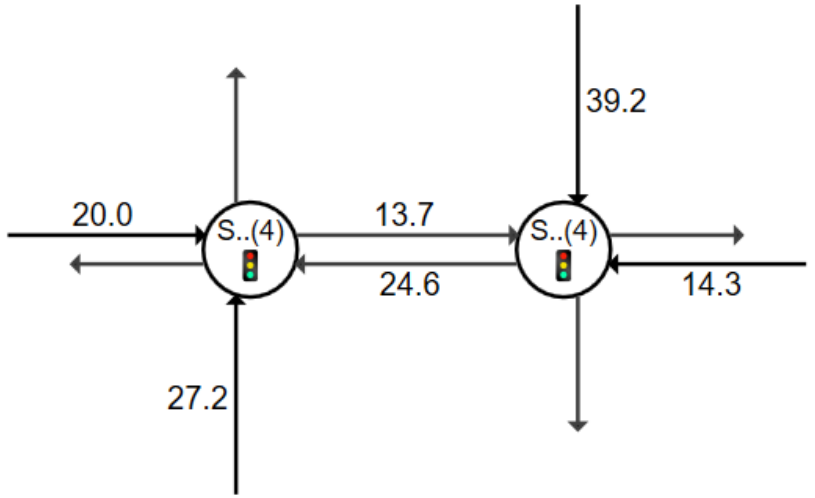
Lane LOS



Average Queue (m)



Average Delay (s)



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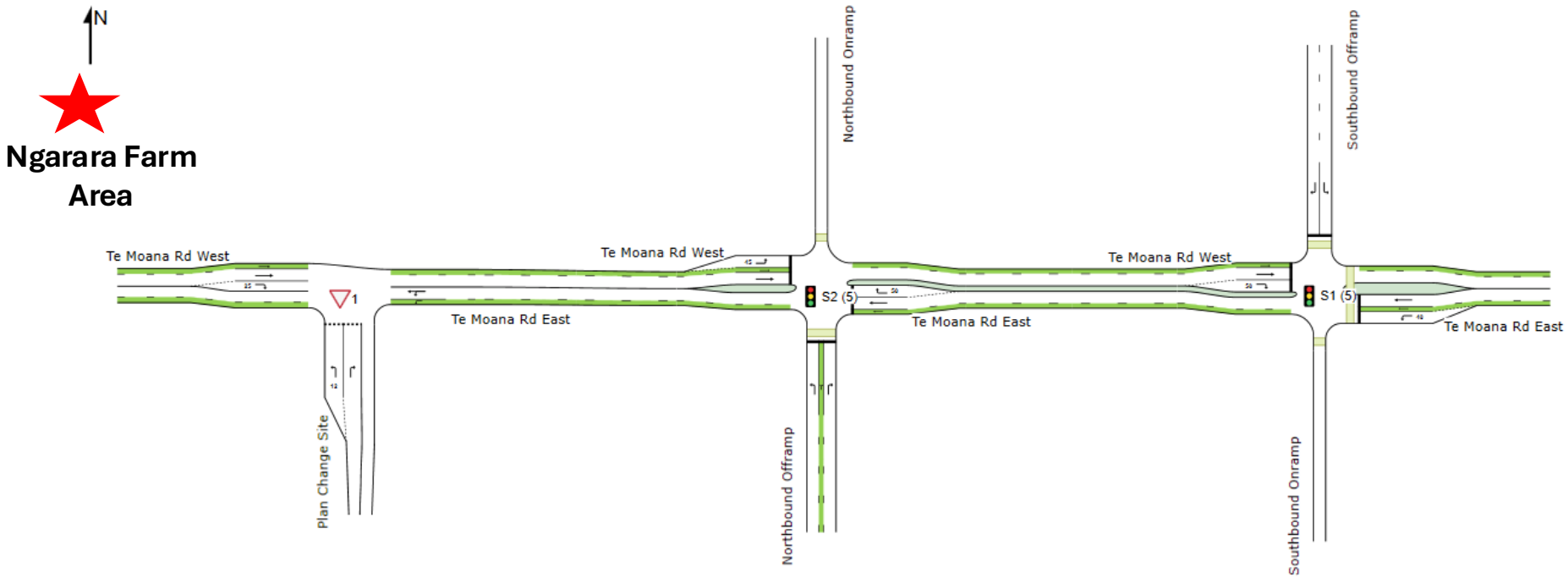
Existing Interchange + Ngarara Farm + Plan Change Site AM & PM Peaks:

- Interchange input volumes provided by WTOC (Wellington Traffic Operations Centre) for the 16th September 2024.
- Additional traffic volumes from Ngarara Farm Plan Change Area (enabled for development) as agreed with council (AM peak: + 578 vehicles & PM peak + 744 vehicles)
- Additional traffic volumes from proposed plan change site based on 50 lots with 3 dwellings per lot @ 0.85v/h for 128 peak hour movements
- Input phasing same as existing interchange
- AM Peak (8am - 9am)
- PM Peak (4:30pm - 5:30pm)
- 6% heavies applied to all movements except proposed plan change site
- Correct geometry including lane lengths, widths etc. applied to all legs of interchange



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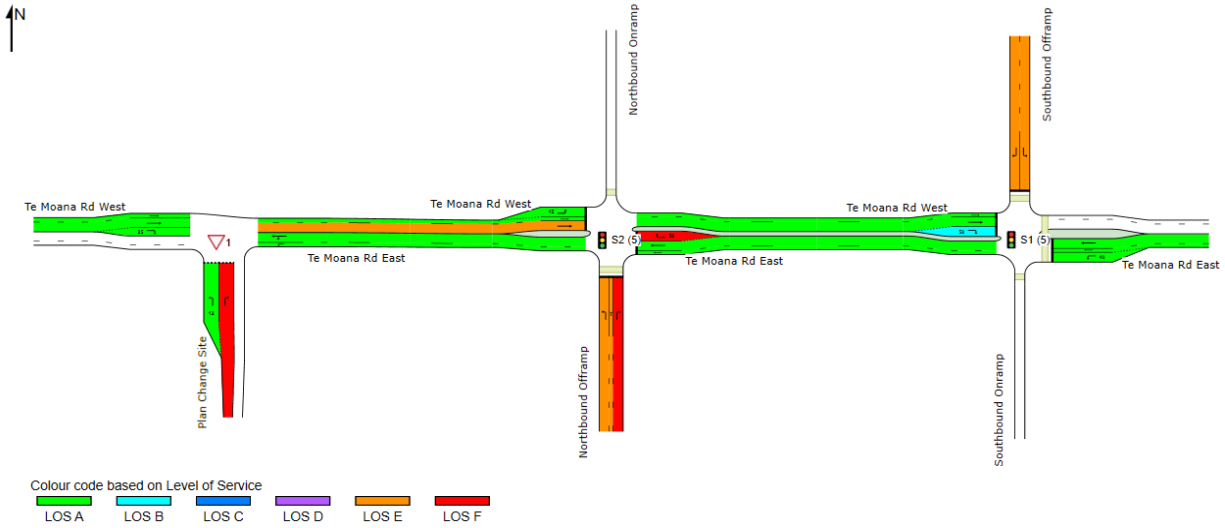
Existing Interchange + Ngarara Farm + Plan Change Site AM Peak Results:

Network Performance

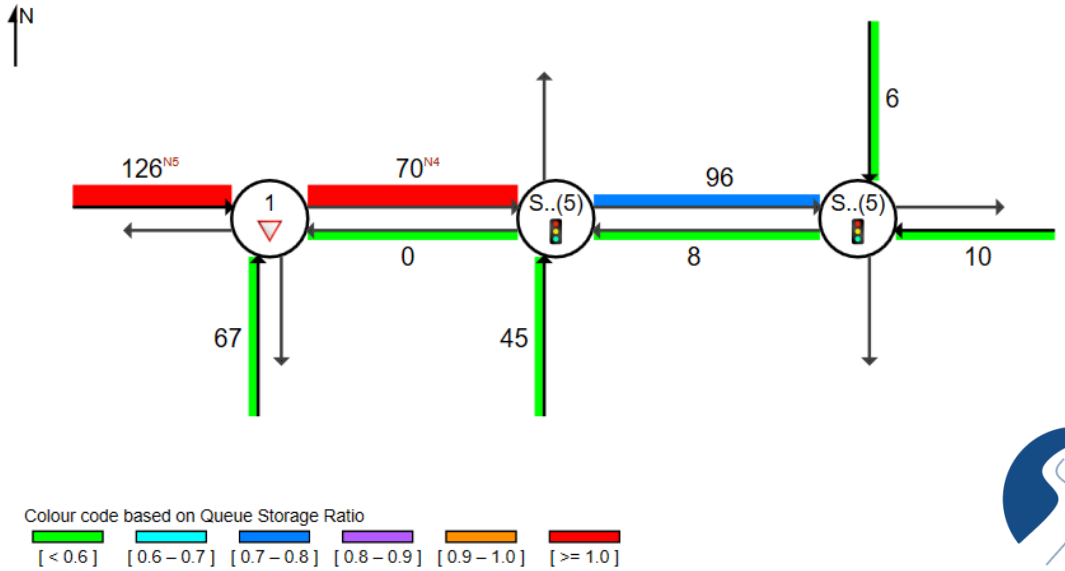
Network Cycle Time = 140.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS D
Speed Efficiency		0.55
Travel Time Index		4.97
Congestion Coefficient		1.83
Travel Speed (Average)	km/h	28.1
Travel Distance (Total)	veh-km/h	1255.8
Travel Time (Total)	veh-h/h	44.7
Desired Speed	km/h	51.3
Demand Flows (Total for all Sites)	veh/h	4660
Arrival Flows (Total for all Sites)	veh/h	4593
Demand Flows (Entry Total)	veh/h	1781
Midblock Inflows (Total)	veh/h	1
Midblock Outflows (Total)	veh/h	-28
Percent Heavy Vehicles (Demand)	%	5.3
Percent Heavy Vehicles (Arrival)	%	5.4
Degree of Saturation		1.448
Control Delay (Total)	veh-h/h	47.14
Control Delay (Average)	sec	37.0
Control Delay (Worst Lane by MC)	sec	438.9
Control Delay (Worst Movement by MC)	sec	438.9
Geometric Delay (Average)	sec	1.4
Stop-Line Delay (Average)	sec	35.5
Ave. Que Storage Ratio (Worst Lane)		2.51
Effective Stops (Total)	veh/h	3071
Effective Stop Rate		0.67
Proportion Queued		0.48
Performance Index		232.1

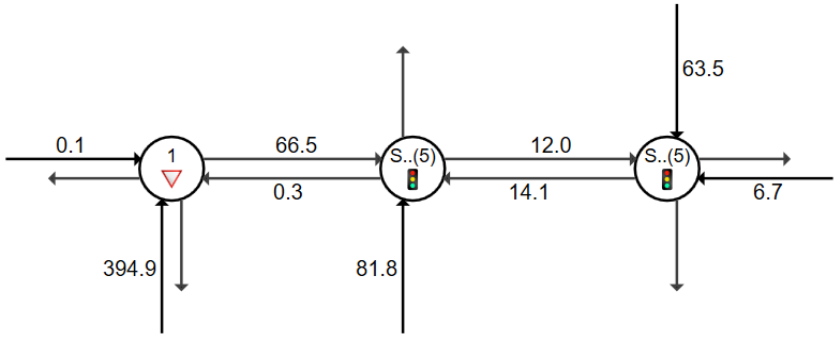
Lane LOS



Average Queue (m)



Average Delay (s)



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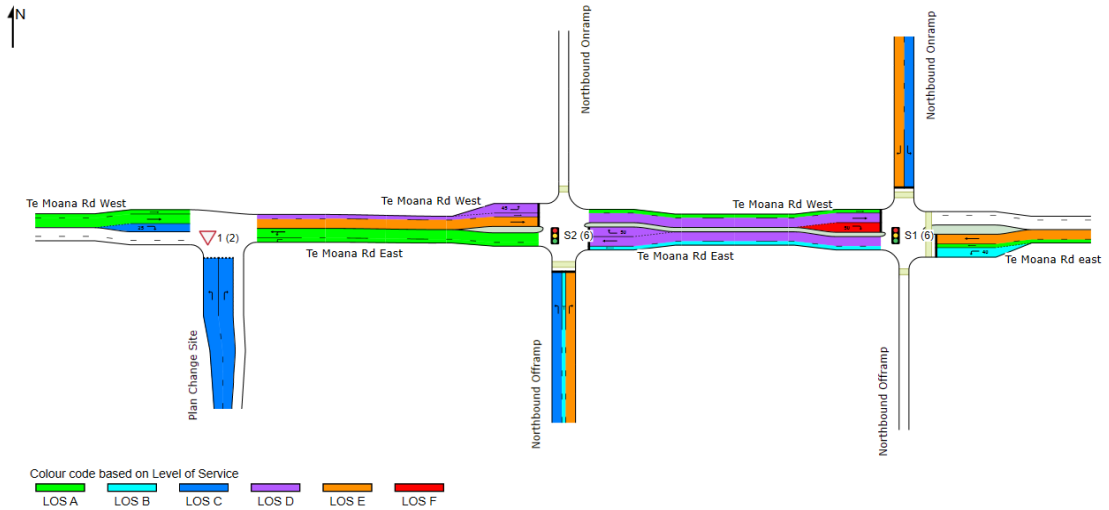
Existing Interchange + Ngarara Farm + Plan Change Site PM Peak Results:

Network Performance

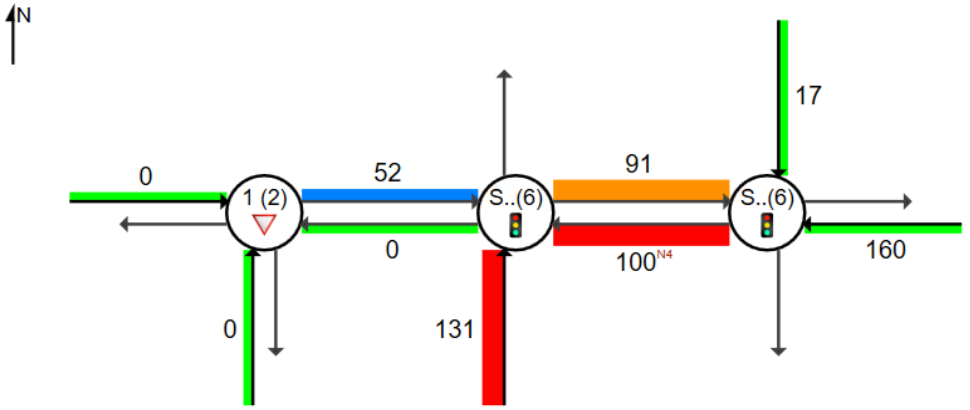
Network Cycle Time = 130.0 seconds (Network Practical Cycle Time)
Critical Site / Common Control Group that determines the Network Cycle Time (for Coordinated Sites):
Network Scenario: 1 | Local Volumes

Network Performance - Hourly Values		
Performance Measure	**Vehicles:**	**All MCs**
Network Level of Service (LOS)		LOS E
Speed Efficiency		0.37
Travel Time Index		2.96
Congestion Coefficient		2.73
Travel Speed (Average)	km/h	19.5
Travel Distance (Total)	veh-km/h	1474.4
Travel Time (Total)	veh-h/h	75.6
Desired Speed	km/h	53.2
Demand Flows (Total for all Sites)	veh/h	4650
Arrival Flows (Total for all Sites)	veh/h	4650
Demand Flows (Entry Total)	veh/h	2005
Midblock Inflows (Total)	veh/h	1
Midblock Outflows (Total)	veh/h	-5
Percent Heavy Vehicles (Demand)	%	3.7
Percent Heavy Vehicles (Arrival)	%	3.7
Degree of Saturation		0.962
Control Delay (Total)	veh-h/h	42.46
Control Delay (Average)	sec	32.9
Control Delay (Worst Lane by MC)	sec	81.1
Control Delay (Worst Movement by MC)	sec	81.1
Geometric Delay (Average)	sec	1.8
Stop-Line Delay (Average)	sec	31.0
Ave. Que Storage Ratio (Worst Lane)		1.54
Effective Stops (Total)	veh/h	3332
Effective Stop Rate		0.72
Proportion Queued		0.63
Performance Index		281.8

Lane LOS



Average Queue (m)



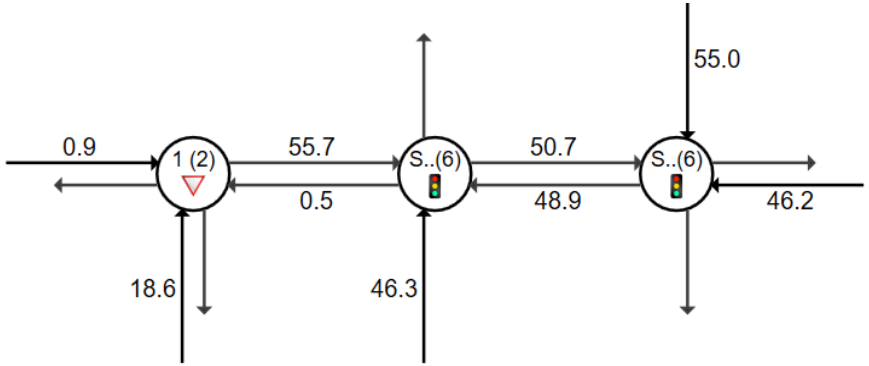
Colour code based on Queue Storage Ratio

[< 0.6] [0.6 – 0.7] [0.7 – 0.8] [0.8 – 0.9] [0.9 – 1.0] [>= 1.0]

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

N4 Average Back of Queue has been restricted to the available queue storage space as it extends to lanes at upstream Sites.

Average Delay (s)



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