TE TUPU NGĀTAHI
SUPPORTING GROWTH

Warkworth Assessment of Transport Effects

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WAKA KOTAHI
NZ TRANSPORT AGENCY

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Glossary of Defined Terms and Acronyms

Acronym/Term	Description
ADT	Average Daily Traffic
AEE	Assessment of Effects on the Environment report
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
AT	Auckland Transport
ATAP	Auckland Transport Alignment Project
ATCOP	AT Code of Practice
AUP:OP	Auckland Unitary Plan: Operative in Part
CEDF	Cultural and Environmental Design Framework
CEMP	Construction Environmental Management Plan
CHI	Cultural Heritage Inventory
CIA	Cultural Impact Assessment
CLMP	Contaminated Land Management Plan
CNVMP	Construction Noise and Vibration Monitoring Plan
CoPTTM	Code of Practice for Temporary Traffic Management
CPTED	Crime Prevention through Environmental Design
CTMP	Construction Traffic Management Plan
DBC	Detailed Business Case
DEB	Decanting Earth Bunds
DSI	Death and Serious Injury
ECR	Auckland Council Environmental Compensation Ratio
EIANZ	Ecological Impact Assessment New Zealand: terrestrial and freshwater ecosystems
EPA	Environmental Protection Authority
ESCP	Erosion and Sediment Control Plan
FESCP	Final Erosion and Sediment Control Plan
FTE	Full Time Equivalent staff
FULSS	Future Urban Land Supply Strategy
FUZ	Future Urban Zone

Acronym/Term	Description
GD01	Auckland Council Guideline Document: Stormwater management devices in the Auckland region, GD2017/001 (an update of TP10)
GD05	Auckland Council Guideline Document: Erosion and Sediment Control Guide, GD2016/005
GHG	Greenhouse Gas emissions
GPS	Government Policy Statement
HAIL	Hazardous Activities and Industries List
HNZPT / Heritage NZ	Heritage New Zealand Pouhere Taonga
IBC	Indicative Business Case
LGA	Local Government (Auckland Council) Act 2009
MCA	Multi-Criteria Assessment
MHUD	Ministry of Housing and Urban Development
N/A	Not Applicable
NES	National Environmental Standard
NES:FW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NES:Soil	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NPS	National Policy Statement
NPS:FM	National Policy Statement on Freshwater Management
NPS:UD	National Policy Statement on Urban Development
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NOR	Notice of Requirement
NOR 1	Northern Public Transport Hub and Western Link - North
NOR 2	Woodcocks Road (Western Section)
NOR 3	State Highway 1 – South
NOR 4	Matakana Road Upgrade
NOR 5	Sandspit Road Upgrade
NOR 6	Western Link - South

Acronym/Term	Description
NOR 7	Sandspit Link
NOR 8	Wider Western Link - North
NZ	New Zealand
NZUP	New Zealand Upgrade Programme
ONF	Outstanding Natural Features
ONL	Outstanding Natural Landscapes
PBC	Programme Business Case
PSI	Preliminary Site Investigation
RCA	Road Controlling Authority
RLTP	Auckland Regional Land Transport Plan
RMA	Resource Management Act 1991
SEA	Significant Ecological Area
SEV	Stream Ecological Valuation
SH1	State Highway 1
SMAF	Stormwater Management Area: Flow
SQEP	Suitably Qualified and Experienced Practitioner
SL	Sandspit Link
SRP	Sediment Retention Pond
SSTMP	Site-Specific Traffic Management Plan
Te Tupu Ngātahi	Te Tupu Ngātahi Supporting Growth Alliance
TDM	AT's Transport Design Manual: AT Engineering Design Codes – Transport Design Manual
UDEF	Urban Design Evaluation and Framework
ULDMP	Urban Landscape and Design Management Plan
Watercare	Watercare Services Limited
Waka Kotahi	Waka Kotahi New Zealand Transport Agency
WL	Western Link
Zero Carbon Act	Climate Change Response (Zero Carbon) Amendment Act 2018

1 Executive Summary

1.1 Overview

The Warkworth Assessment Package is a network of planned transport infrastructure with the purpose of responding to planned future growth in the Warkworth growth areas. The transport network is made of eight NORS including new corridors, existing road upgrades, and a public transport interchange with park and ride.

Table 1-1. Warkworth Assessment Package – NOR and Project Overview

Notice	Project
NOR 1	**Northern Public Transport Hub and Western Link – North**
NOR 2	**Woodcocks Road Upgrade (Western Section)**
NOR 3	**State Highway 1 South – Upgrade**
NOR 4	**Matakana Road Upgrade**
NOR 5	**Sandspit Road Upgrade**
NOR 6	**Western Link - South**
NOR 7	**Sandspit Link**
NOR 8	**Wider Western Link – North**

This Transport assessment has been prepared as part of the Assessment of Environmental Effects (AEE), for the Warkworth Notices of Requirement (**NoRs**) for Auckland Transport (**AT**) (the "Warkworth Assessment Package"). The NORS are to designate land for new corridors, existing road upgrades, and a public transport interchange with park and ride as part of Te Tupu Ngātahi Supporting Growth Programme (**Te Tupu Ngātahi**) to enable the construction, operation and maintenance of transport infrastructure in Warkworth.

In addition to the corridors detailed in this ITA, there are other identified projects in Warkworth that form part of the overall network solution for the area. These projects are not specifically included in this package of NORS but interface with the projects within this ITA and are discussed on a project basis in this report.

1.2 Methodology

This transport assessment has considered potential effects on the transport system both during construction as well as effects once the projects are operational. The focus of the Te Tupu Ngātahi is on long-term route protection of the transport systems required to support the planned growth areas. This means that implementation of the proposed projects is typically not imminent and would be preceded by updated implementation investment and design processes. This focus on longer-term route protection for longer-term implementation means that this assessment has focused less on detailed analysis of the existing environment and more on the likely future (urbanized) environment and potential effects of the proposed projects.

It is also noted that the Warkworth network has been designed as an overall integrated system, but in general individual projects can typically be delivered separately. As such this assessment considers the projects individually – with commentary on interdependencies where appropriate.

1.2.1 Approach to Assessment of Operational Transport Effects

Potential operational transport effects are assessed using: ·

- Transport planning assessment of expected outcomes and effects
- Transport modelling to inform demands and network performance
- Alignment with various policy documents

In respect to each individual NoR, a separate assessment has been undertaken, and the assessment criteria and methodology is summarised in Table 1-2 below.

Table 1-2: Summary of Assessment Methodology

Network Component	Information Source	Assessment Method
Safety	Crash Analysis (CAS) Database Project design drawings	Assessment to determine alignment with Vision Zero standards and design compliance with Transport Design Manual
Walking and Cycling	Walking and Cycling Network Plans Proposed Cross Sections	Assessment to determine alignment with walking and cycling strategic documents and design compliance with Transport Design Manual
Public Transport	Transport Model tools (MSM, SATURN and SIDRA) Supporting Growth Indicative Future Public Transport Network (Remix)[1]	Assessment to determine alignment with future network provisions and design compliance with the Transport Design Manual
General Traffic	Transport Model tools (MSM, SATURN and SIDRA) Project design drawings	Assessment using key model outputs including traffic volumes, levels of service for corridor midblock performance and intersection performance.

[1] SGA Remix file provided by Auckland Transport on the draft plan of the bus network to be implemented by 2048

Network Component	Information Source	Assessment Method
		Assessment of surrounding network connections
Property Access	Engineering Standards	Assessment identifying where there is a potential effect on access in the existing environment
Wider Network Effects	Transport Model tools (MSM, SATURN and SIDRA)	Assessment to consider how the corridor interacts with the surrounding road network
Note: A Road Safety and Audit and Safe System assessment with be done as part of the implementation business case/detailed design stage prior to implementation.		

1.2.2 Approach to Assessment of Construction Effects

Based on the indicative construction methodology an assessment of construction effects has been completed for the package sufficient to support each Notice of Requirement. This assessment considers:

- An overview of key considerations including speed, potential impacts to pedestrians and cyclists and property access
- Identification of any works that should not occur at the same time
- Assessment of potential conflict areas with vulnerable road users that will need specific mitigation within a Construction Traffic Management Plan (CTMP).

The impact of any temporary traffic management measures implemented to undertake the projects will be re-assessed in the future, prior to construction, when a greater level of detail is available in terms of the specific construction methodology and traffic environment.

1.3 Warkworth NORS Overall Network

Overall, the Warkworth Detailed Business Case identified a network that provides for a comprehensive transport solution that responds to planned growth. It is noted that this ITA considers these projects as a network and has an overall focus on the outcomes for the Warkworth area. The NORS are all proposed as separate projects and can be implemented progressively in coordination with progressive land use development.

The eight notices of requirement identified in this ITA are a core component of this network, with the proposed projects supporting the following transport outcomes:

- Long term development of a low carbon transport system to support future growth and facilitates mode shift from private vehicles to public transport and active modes to reduce greenhouse gas emissions.
- People living and working in Warkworth as part of the Satellite Town vision with direct freight connections to planned industrial land use and improved access to employment and social amenities.

- Transport corridors to maximise opportunities for walk up catchments to public transport interchanges and a high frequency local bus network.
- Increased reliability for public transport and additional resilience via urbanised alternative routes.
- Real travel choice with high quality, attractive alternatives to the private vehicle. This includes a continuous, legible active mode network that connects people to key destinations and encourages active mode trips within the compact urban area.
- An area wide focus on safety through a holistic set of measures including Road to Zero safety principles, fully separated cycling facilities, well designed intersections and sufficient space for all modes to interact safely.

1.4 Warkworth NORS – Individual Effects

Error! Reference source not found.**: Summary of the transport effects related to each proposed NOR within the Warkworth Package.**

NOR	Corridor	Summary of Operational and Construction Effects
1	Western Link - North and PT Hub	Overall, the project provides positive transport effects, in particular improved public transport outcomes, and active mode facility improvements, improving safety for those that walk and cycle. There are no identified adverse operational effects. There is considered to be a significant opportunity improve access to the cemetery adjacent to the project. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.
2	Woodcocks Road Upgrade (Western Section)	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. At the time of implementation, the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network. For Woodcocks Road this will include consideration of the existing land use activities such as light industrial activities, residential and educational activities. The Urban Design and Landscape Plan condition requires that these matters be confirmed prior to implementation.

NOR	Corridor	Summary of Operational and Construction Effects
3	State Highway 1 Upgrade - South	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.
4	Matakana Road Upgrade	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.
5	Sandspit Road Upgrade	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.
6	Western Link - South	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

NOR	Corridor	Summary of Operational and Construction Effects
		In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.
7	Sandspit Link	Overall, the project provides positive transport effects, particular improved safety and active mode improvements. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP. It is recommended that access considerations relating to the Quarry and the recycling plant should be specifically considered within the CTMP prior to construction and implementation of the project.
8	Wider Western Link – North	Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP

2 Introduction

This Transport assessment has been prepared for the Te Tupu Ngātahi Supporting Growth Alliance, Warkworth Package of Notices of Requirement (NoRs) for Auckland Transport (AT) as requiring authority under the Resource Management Act 1991 (RMA). The notices are to designate land for future strategic transport corridors as part of Te Tupu Ngātahi Supporting Growth Alliance to enable the future construction, operation and maintenance of transport infrastructure in the Warkworth area of Auckland.

2.1 Warkworth Growth Area

Warkworth is located at the northernmost extent of the Auckland Region, approximately 60km from the Auckland city centre, and 30km north of Orewa. It is identified as a satellite town in the Auckland Unitary Plan: Operative in Part (AUP: OP) and will act as a rural node that serves both the surrounding rural communities as well as connecting to urban Auckland.

The Warkworth growth area is approximately 5km north-south and east-west and will contribute to the future growth of Auckland's population. A 1,000 ha of currently rural land has been rezoned (Future Urban Zone) to support significant business and residential growth. At full build out it is anticipated to provide for approximately 7,300 new dwellings and employment activities that will contribute to 4,600 new jobs across Warkworth. This growth area is expected to be development ready in the stages outlined below:

- **Stage 1** Warkworth North – Predominantly Business land with some residential- already live zoned by 2022
- **Stage 2** Warkworth South – To be development ready between 2028 – 2032
- **Stage 3** Warkworth Northeast – To be development ready between 2033 – 2037

Furthermore, the Warkworth Structure Plan was adopted by the Council in 2019 and sets out the framework for transforming Warkworth from a rural environment to an urbanised community over the next 15 - 20 years.

It is noted that parts of these areas are experiencing earlier than anticipated growth pressure, with parts of Warkworth South subject to a lodged Private Plan Change, as well as sections of Warkworth Northeast[2].

The Warkworth Assessment Package will provide route protection for the local arterials, which include walking, cycling, and public transport linkages needed to support the expected growth in Warkworth. The Warkworth Package of projects is summarised in Section 3.

2.2 Purpose and scope of this Report

This transport assessment forms part of the suite of technical reports prepared to support the assessment of effects (AEE) for the Warkworth Package. Its purpose is to inform the AEE that accompanies the eight Warkworth Network NOR sought by AT.

This report considers the actual and potential effects associated with the construction, operation and maintenance of the Warkworth Package on the existing and likely future environment as it relates to

[2] https://www.aucklandcouncil.govt.nz/have-your-say/have-your-say-notified-resource-consent/Pages/resource-consent-public-notice.aspx?itemId=194&src=Search

transport effects and recommends measures that may be implemented to avoid, remedy and/or mitigate these effects.

The key matters addressed in this report are as follows:

a) Identify and describe the transport context of the Warkworth Assessment Package area;
b) Identify and describe the actual and potential transport effects of each project corridor within the Warkworth Assessment Package;
c) Recommend measures as appropriate to avoid, remedy or mitigate actual and potential transport effects (including any conditions/management plan required) for each project corridor within the Warkworth Assessment Package; and
d) Present an overall conclusion of the level of actual and potential effects for each project corridor within the Warkworth Assessment Package after recommended measures are implemented.

This report should be read alongside the AEE, which contains further details on the history and context of the Warkworth project. The AEE also contains a detailed description of works to be authorised within each NOR, and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this report and have been considered as part of this assessment of transport effects. As such, they are not repeated here. Where a description of an activity is necessary to understand the potential effects, it has been included in this report for clarity.

2.3 Report Structure

The report has been split into several sections, covering the following:

Sections 3 summarises the approach and methodology used for the assessment of operational transport effects

Sections 4 to 5 outlines the existing and future transport environment for each of the corridors on the Warkworth network. This is followed by an assessment of the positive effects and constructions effects of the overall Warkworth network.

Sections 5 to 13 includes an assessment of NOR specific details related to each of the projects in Warkworth.

There are several appendices to this report that provide additional details, specifically:

- Appendix A: RASF assessment of each of the corridors in Warkworth.
- Appendix B: Existing crash records for Warkworth
- Appendix C: Transport modelling background information

3 Warkworth Package Overview

The Warkworth package is a network of planned transport infrastructure with the purpose of responding to planned future growth in the Warkworth growth areas. The transport network is made of eight NORS including a public transport interchange, existing road upgrades, and new corridors.

These projects have been identified in the Warkworth Detailed Business Case and sit alongside several other projects in the Warkworth area that are underway or planned for this area. These projects are primarily needed to provide a transport system suitable for the planned urban growth, that provides for improved accessibility, resilience and land use integration within Warkworth. Further high-level information on these projects is included in Section 4.2.3.

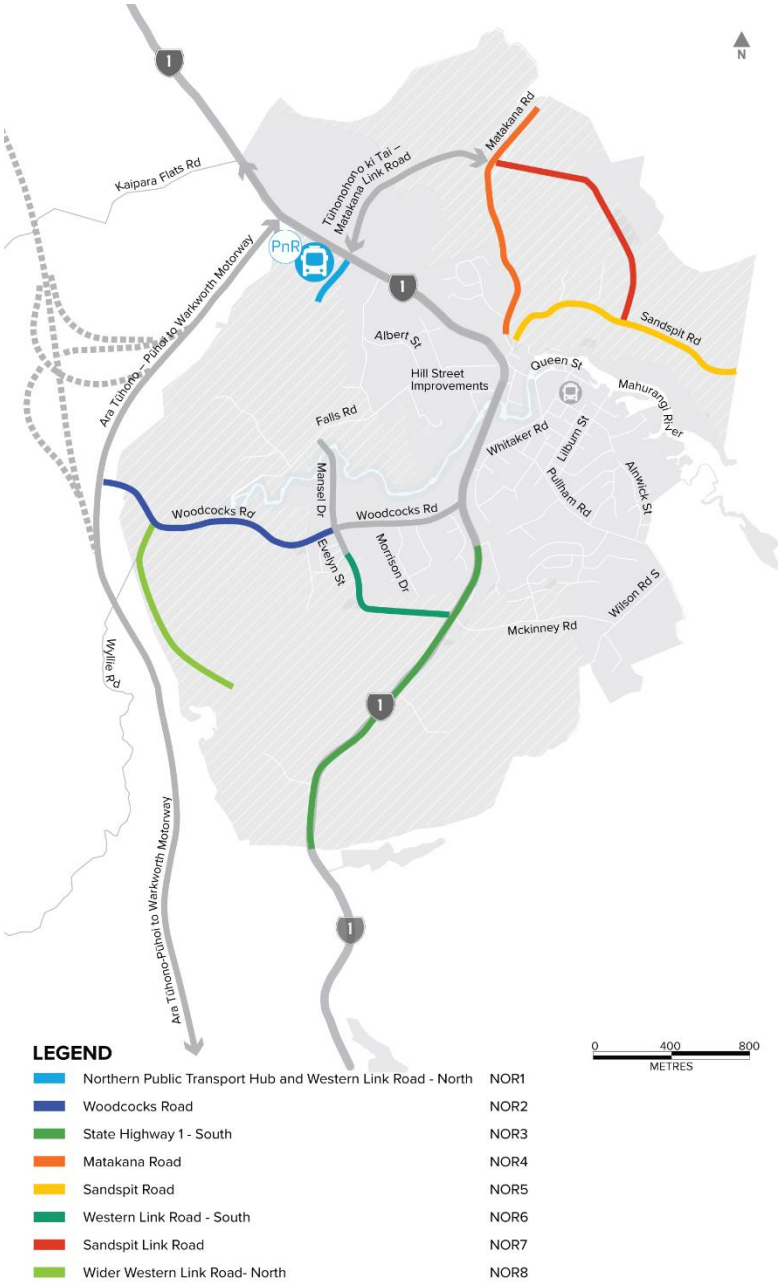
An overview of the Warkworth NOR package is set out in Table 3-1 and shown in Figure 3-1.

Table 3-1. Warkworth NOR Package

Corridor	NOR	Description	Requiring Authority
Northern Public Transport Interchange + Park and Ride and Western Link – North	1	Construction of a public transport hub with associated facilities + park and ride facility (approximately 220 carparks). Construction of a four lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport
Woodcocks Road Upgrade (Western Section)	2	Upgrade of Woodcocks Road to a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport
State Highway 1 Upgrade (Southern Section)	3	Upgrade of State Highway to a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport
Matakana Road Upgrade	4	Upgrade of Matakana Road to a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor. It should be noted that the southern extent of Matakana Road (Hill Street to Melwood Drive) has a bidirectional facility for cyclists.	Auckland Transport
Sandspit Road Upgrade	5	Upgrade of Sandspit Road to a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor and an offline walking and cycling path at the western extent.	Auckland Transport
Western Link - South	6	Construction of a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport
Sandspit Link	7	Construction of a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport

Corridor	NOR	Description	Requiring Authority
Wider Western Link - (Northern Section)	8	Construction of a two lane urban arterial cross-section with cycle lanes and footpaths on the corridor.	Auckland Transport

Figure 3-1: Warkworth NOR package Overview



3.1 Assessment Methodology

Given the long-term nature of the designations being sought by the NORs, this assessment does not assess the interim staging of individual projects and development staged over the next three decades but instead places a greater focus on the 'full build out' of the future urban area in 2048+ to support future communities. Therefore, this assessment focusses on the likely future environment (full build out 2048+) and wider infrastructure upgrades.

The methodology for the operational and construction transport effects are applicable for each NOR specified within this document. Any nuances are specified throughout the assessment.

The Assessment of Transport Effects has two elements:

- Assessment of operational effects on the transport system
- Assessment of construction effects on the transport network

The assessment is targeted at route protection, rather than imminent implementation. As such, it:

- Makes greater use of generic cross-sections and design standards ·
- Focuses more on desired outcomes and footprints
- Takes a longer-term view, with its inherent uncertainties
- Assumes more use of recommended management plans and planning processes rather than specific design details to manage potential effects

A key element of the assessment is the definition of the 'existing/likely future environment', against which the effects are assessed. This is a complex issue as the proposed works are planned to support urban development and will be unlikely to occur without such development. Additionally, the source of the potential effects (such as people and vehicle movements), is generally from urban development itself, rather than from the planned infrastructure.

To isolate the effects of the planned works, the 'Existing Environment' includes the likely future urban development but does not include the planned projects for which designations are sought. The effects of the projects are then assessed using the same land use assumptions. Given the long-term perspective of the assessment, the analysis is based on the estimated 'full build out' for the future urban area. This is based on development yield estimates provided by Auckland Council through the Warkworth Structure Plan and the Auckland Forecast Centre.

3.2 Approach to Assessment of Operational Transport Effects

This transport assessment has considered potential effects on the transport system both during construction as well as effects once the projects are operational. The focus of the Te Tupu Ngātahi is on long-term route protection of the transport systems required to support the planned growth areas. This means that implementation of the proposed projects is typically not imminent and would be preceded by updated implementation investment and design decisions.

This focus on route protection for longer-term implementation has meant that this assessment has focused less on detailed analysis of the existing environment and more on the likely future (urbanised) environment and potential effects of the proposed projects.

It is also noted that the Warkworth network has been designed as part of an overall integrated system, but in general the projects can be delivered separately. As such this assessment considers the projects individually – with commentary on interdependencies where appropriate.

Section 3.2.3 outlines the methodology for the operational transport effects assessment.

3.2.1 Transport Modelling

Throughout the transport network analysis process, a range of different transport modelling tools have been used to undertake quantitative assessments of the transport system. These then inform decisions about planning the transport network, corridors, and intersections.

The impacts of the projects on the future transport environment are assessed using forecasting transport models, owned by the Auckland Forecasting Centre (AFC). The models include:

- The regional multi-modal model (MSM). This model creates estimates of car, truck and public transport movements at a regional level based on land use, network and policy inputs. This model is the primary tool to estimate future PT usage. Generally, this model is run using regional assumptions, but with scenario-specific inputs in the growth areas.
- A local traffic model (SATURN). This uses the traffic demands from MSM on a more detailed representation of the road network.
- A strategic active model (walk/cycling) model (SAMM). This tool gives strategic-level estimates of walking and cycling demands.

The assessment of operational effects will therefore be informed by network performance for a future full-build-out scenario based on the Future Urban Land Supply Strategy.

A key input to the models are regional land use forecasts, which influence the future quantum and location of travel. Regionally agreed land use forecasts are prepared by Auckland Council via the Auckland Forecasting Centre (AFC), with the most recent available forecasts (at the time of this assessment), referred to as Scenario I11.6. Those forecasts are based on regional population forecasts from Statistics NZ, with spatial allocation to individual spatial areas based on the AFCS land use model and known detail around specific land use planning processes.

Land use forecasts have inherent uncertainty, in terms of the specific rate of new growth in specific areas. Currently, there is additional uncertainty around the likely outcomes and rate and location of higher-density development sought through central Government policies such as the National Policy Statement on Urban Development (NPS-UD) and Auckland Council's Plan Change 78. A key intent of those policies is to enable higher density development, especially around high-quality public transport systems. The specific planning response to those policies is currently being progressed by Auckland Council, and revised land use forecasts reflecting any expected changes were not available at the time of preparing this assessment. Generally, it is considered that this Project is not inconsistent with such policy direction, regarding supporting higher density urban development via more sustainable travel modes. Given this context, the use of those available I11.6 forecasts is considered acceptable for this assessment.

In addition to the SATURN modelling, SIDRA modelling has been undertaken to assess the operational outputs of key intersections along the project corridors. The regional model (MSM) was used to inform assessment of the public transport network components.

In regard to local traffic modelling analysis used in this report, a Level of Service (LOS) metric has been used. This refers to a qualitative measure used to assess the quality of motor vehicle traffic service. LOS is used to analyse road corridors and intersections by categorising traffic flow and assigning quality levels of traffic based on a performance measure ranging from A to F and can be summarised as follows:

- **LOS A**: free flow. Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes.
- **LOS B**: reasonably free flow. LOS A speeds are maintained, manoeuvrability within the traffic stream is slightly restricted.
- **LOS C**: stable flow, at or near free flow. Ability to manoeuvre through lanes is noticeably restricted and lane changes require more driver awareness.
- **LOS D**: approaching unstable flow. Speeds slightly decrease as traffic volume slightly increase. Freedom to manoeuvre within the traffic stream is much more limited and driver comfort levels decrease.
- **LOS E**: unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to manoeuvre in the traffic stream and speeds rarely reach the posted limit.
- **LOS F**: forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity.

3.2.2 Transport Guidance and Documents

Within this report, the projects have also been considered against the outcomes and objectives of applicable transport design guidance and policy directives including:

- AT's Transport Design Manual, which sets out outcomes, engineering design and construction requirements for the projects
- AT's Vision Zero, which adopts a "Safe System" approach to focus on road safety for all road users
- AT's Roads and Streets Framework (**RASF**)[3] was also used to qualitatively assesses the typology (movement and place value) and modal priority for each corridor. A 'mandate' for each road corridor is developed and approved by the Auckland Transport RASF Committee, comprising of senior officers from AT and AC. These are included in Appendix 1.

3.2.3 Assessment Methodology – Transport Mode

Table 3-2 summarises how each mode/element of transport has been assessed in terms of operational effects as a result of the projects.

Table 3-2: Assessment Methodology for Transport Elements/Modes

Network Component	Information Source	Assessment Method
Safety	Crash Analysis (CAS) Database Project design drawings	Assessment to determine alignment with Vision Zero standards and design compliance with Transport Design Manual

[3] https://at.govt.nz/about-us/transport-plans-strategies/roads-and-streets-framework/

Network Component	Information Source	Assessment Method
Walking and Cycling	Walking and Cycling Network Plans Proposed Cross Sections	Assessment to determine alignment with walking and cycling strategic documents and design compliance with Transport Design Manual
Public Transport	Transport Model tools (MSM, SATURN and SIDRA) SGA Remix File[4]	Assessment to determine alignment with future network provisions and design compliance with the Transport Design Manual
General Traffic	Transport Model tools (MSM, SATURN and SIDRA) Project design drawings	Assessment using key model outputs including traffic volumes, levels of service for corridor midblock performance and intersection performance. Assessment of surrounding network connections
Property Access	Engineering Standards	Assessment identifying where there is a potential effect on access in the existing environment
Wider Network Effects	Transport Model tools (MSM, SATURN and SIDRA)	Assessment to consider how the corridor interacts with the surrounding road network
Note: A Road Safety and Audit and Safe System assessment will be done as part of the implementation business case/detailed design stage prior to implementation.		

3.2.4 Intersection Form

To determine the intersection form an assessment process was undertaken as part of the Warkworth Detailed Business Case to identify likely intersection forms for the recommended network. The purpose of this process was to identify the indicative intersection controls and subsequent designation footprint implications.

However, it is noted that the final decision of the form and control of the intersections can be modified when further land use certainties are known at time of implementation. This is detailed in the Conditions, which confirms that intersection form will be confirmed as part of the Urban and Landscape Design Management Plan (ULDMP). The designation does allow for flexibility in this regard.

To determine the intersection form contained within the indicative designs the following factors were considered:

- Safety.
- Transport network function (movement) and land use function (place).
- Form and Level of Service (LOS) / Quality of service required for different modes.
- Land use integration.
- Site specific constraints.

[4] SGA Remix file provided by Auckland Transport on the draft plan of the bus network to be implemented by 2048

- Urban form.
- Design constraints.
- Roundabout vs signals guidance.
- Network staging and route protecting.
- Future land used assumptions.
- Future transport network assumptions.

For each intersection control chosen, design features were also considered to ensure that the intersection meets the needs of different users safely and effectively while responding to the site-specific factors. This check was completed by the engineering and urban design teams following the initial selection process completed by the transport planning team.

The guidance adopts a 'Safe System' approach and recommends roundabouts as the first choice for at-grade intersections due to the safety benefits for vehicular traffic resulting from slowing down through traffic and reducing the number of conflict points. However, where roundabouts are not considered appropriate, for example due to engineering constraints or land use implications, signalised intersections were then considered.

3.2.5 Assessment of Project Objectives

Each project included in the Warkworth Assessment Package has an identified set of project objectives. From a transport perspective, these objectives are focused predominantly on the themes of supporting growth, safety, urban form, mode shift/choice and connectivity. The assessment of these, and how they align with the project objectives are included in the AEE.

3.2.6 Approach to Assessment of Construction Effects

3.2.6.1 Construction Traffic Effects

In order to assess the potential construction traffic effects, an indicative construction methodology has prepared. This can be found in the AEE.

Based on the indicative construction methodology an assessment of construction effects has been completed for the package sufficient to support each Notice of Requirement. This assessment will consider:

- An overview of key considerations including speed, potential impacts to pedestrians and cyclists and property access
- Identification of any works that should not occur at the same time
- Assessment of potential conflict areas with vulnerable road users that will need specific mitigation within a Construction Traffic Management Plan (**CTMP**) and / or Site-Specific Traffic Management Plans (**SSTMP**).

The project specific construction effects will be managed via a CTMP and/or SSTMP which will be developed immediately prior to implementation when the greatest certainty is available.

3.2.6.2 Temporary Traffic Management

The impact of any temporary traffic management measures implemented to undertake the projects will be re-assessed in the future, prior to construction, when a greater level of detail is available in terms of the specific construction methodology and traffic environment.

It is noted that there may be some nuances between projects delivered ‘online’ as they are existing roads and those delivered ‘offline’ as new greenfield roads. There are also corridors that are both existing and new roads. In particular, any future assessment should be required to consider potential road closures, any capacity reductions on key corridors through lane closures, and any other ancillary effects such as shoulder closures.

4 Existing and likely receiving environment

4.1 Planning and Land Use Context

The projects encompassing the Warkworth NOR package will be constructed 15 - 20 years from now. The implementation timeframe for each project will vary and correspond with future land release within the area. Assessing the effects on the environment solely as it exists today (i.e., at the time of assessment) will not provide an accurate reflection of the environment in which some of the effects will be experienced. Accordingly, the assessment of effects considers both the existing environment, and the likely receiving environment in which the effects will likely occur.

The Warkworth NOR package will be constructed and will operate alongside existing urban environments or planned future environments (i.e. what can be built under the existing Auckland Unitary Plan: Operative in Part (AUP:OP) and what is identified in the Warkworth Structure Plan):

- **Existing environment:** A number of corridors comprising the Warkworth NOR package are partially located within/alongside existing urban areas.
  - Matakana Road Upgrade – residential land uses (single house zone, mixed housing suburban zone, mixed housing urban zone) comprise the western and north-western extents of the corridor.
  - Western Link South – residential land uses are situated to the north and northwest of the corridor and existing industrial land use on the eastern extent of the corridor.
  - State Highway 1 (Southern Section) – residential land uses are adjacent to the northwest and southeast of the northern extent of the corridor, additionally there are established business land uses to the northeast of the northern extent of the corridor.
  - Woodcocks Road – the eastern extent of the corridor has existing residential land uses to the north and south.
- **Future environment**: All the corridors in the Warkworth NOR package will partially or wholly be constructed and implemented on land identified for future growth (future urban zone) and as a result are anticipated to change to urban or industrial land uses.

In terms of specific corridors the below table summarises the likelihood for land use change and likely future environment.

Table 4-1: Summary of Future Land use Expectations

Corridor	Environment today	Zoning	Likelihood of Change for the environment[5]	Likely Future Environment[6]
Woodcocks Road	**Residential**	Residential	Low	Residential
	Undeveloped greenfield areas	Future Urban	High	Urban
	Residential	Single House	Low	Residential

[5] Based on AUP:OP zoning/policy direction
[6] Based on AUP:OP zoning/policy direction

Corridor	Environment today	Zoning	Likelihood of Change for the environment[5]	Likely Future Environment[6]
Matakana Road	**Undeveloped greenfield areas**	Future Urban	High	Urban
	Undeveloped greenfield areas	Mixed Housing Urban	High	Urban
Sandspit Road	**Residential**	Single House	Low	Residential
	Undeveloped greenfield areas	Future Urban	High	Urban
SH1	**Residential**	Single House	Low	Residential
	Undeveloped greenfield areas	Future Urban	High	Urban
Western Link South	**Undeveloped greenfield areas**	Future Urban	High	Urban
Wider Western Link - North Wider Western Link	**Undeveloped greenfield areas**	Future Urban	High	Urban
Sandspit Link	**Undeveloped greenfield areas**	Future Urban	High	Urban

Please refer to the AEE for further information on the planning context.

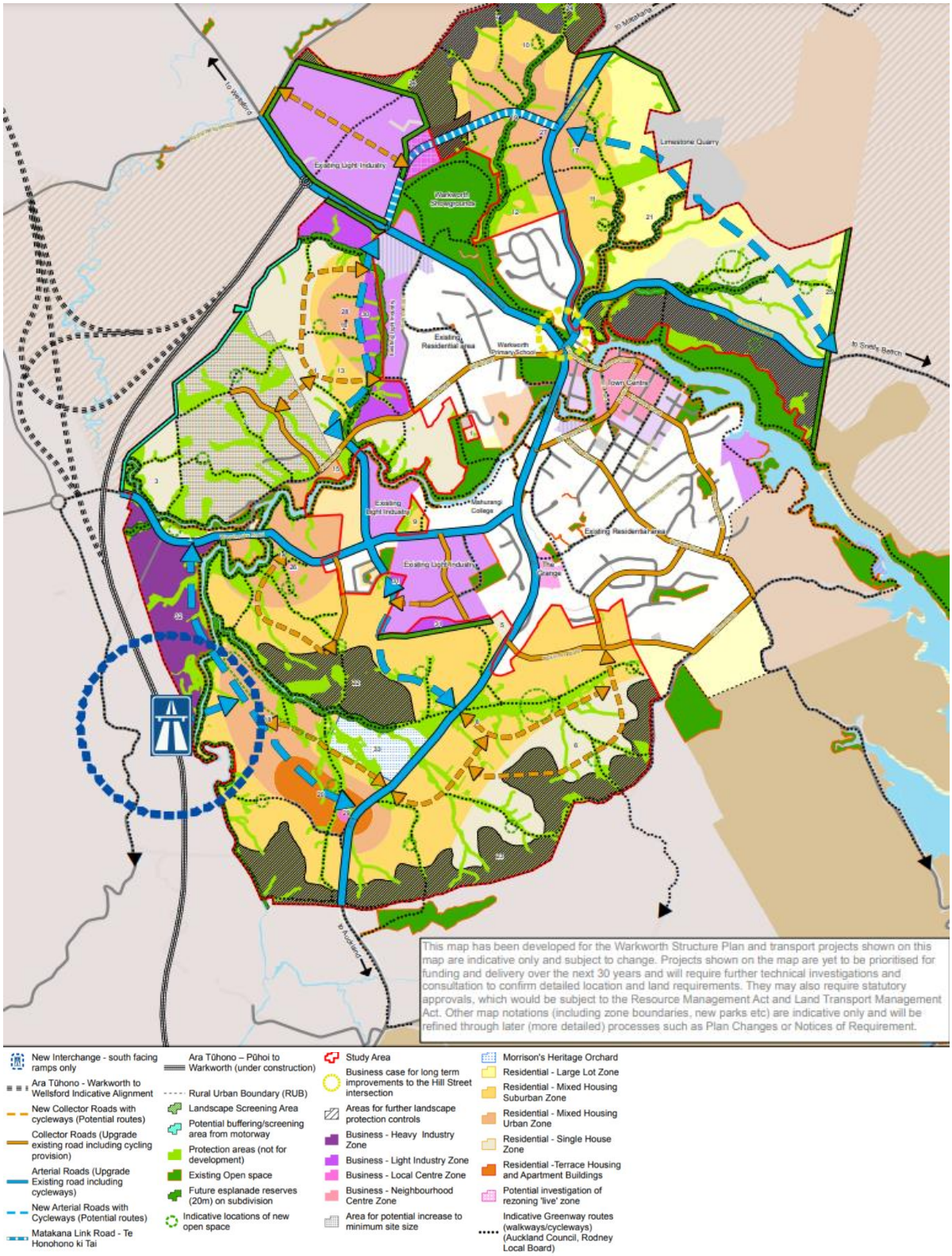
4.1.1 Warkworth Structure Plan

The Warkworth Structure Plan was completed and endorsed by Auckland Council in June 2019. The Warkworth Structure Plan sets out a pattern of land uses and the supporting infrastructure network for the Future Urban zoned land around Warkworth. The final land use proposed by the Structure Plan is shown below in Figure 4-1.

This land use scenario has been considered as the most likely land use outcome and has been used as the basis for determining the Warkworth transport network. The process was also iterative, noting that landuse and transport are inherently linked.

It is noted that the indicative cross sections used to inform the proposed designations may change in the future when there is greater certainty of landuse, however is it considered these changes can be accommodated within the footprint of the designation.

Figure 4-1: Warkworth Structure Plan



4.1.2 Warkworth North Precinct (AUP: PC25)

Subsequent to the development of the Warkworth Structure Plan, a private plan change (Plan Change 25) was approved. There are some differences between the Structure Plan and the eventual unitary plan zoning, including a zoning for a local centre higher residential densities and a reserve area. These land uses have since been incorporated into the Auckland Unitary Plan.

Figure 4-2: Warkworth North: Structure Plan

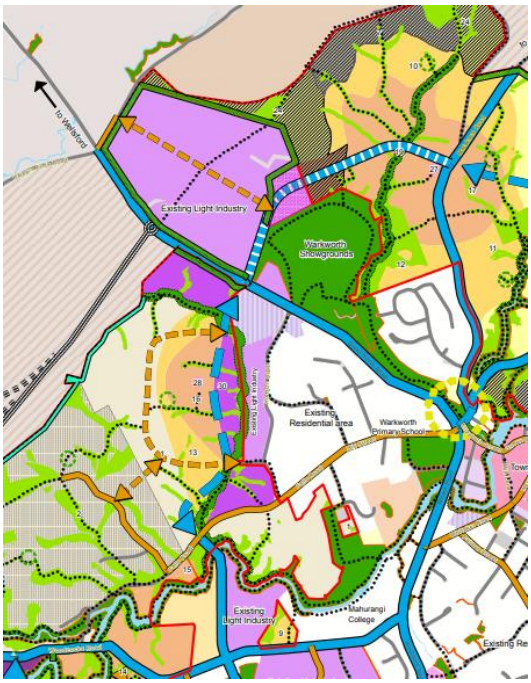
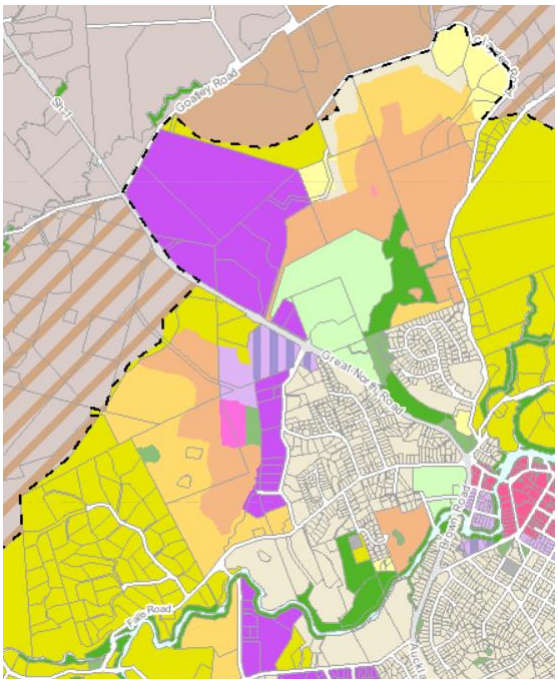


Figure 4-3: Warkworth North AUP



4.1.3 Claydon Road Precinct (AUP: PC40)

The Claydon Road precinct rezoned approximatly 102ha of Future Urban and Light Industrial land to a Residential – Single House, Residential – Mixed Housing Suburban, Residential – Mixed Housing Urban, Business Neighbourhood Centre and Rural – Countryside Living. This Plan Change was fully operative in June 2021.

4.2 Existing and Future Environment - Transport

4.2.1 Existing Transport Environment

The following table provides a summary of the existing road network as it relates to the proposed Notice of Requirements. Overall, the following conclusions can be made:

- Where urbanisation is yet to occur, corridors are predominantly rural in nature, including limited footpaths and cycle infrastructure and generally a higher speed environment.
- Intersections in the rural environment are predominantly uncontrolled, which is commensurate with traffic volumes and surrounding environment.
- Existing SH1 currently operates as the main north south route from Auckland. This will be imminently replaced by Ara Tūhono.

Table 4-2: Existing Transport Environment

NOR	Project	Existing Transport Characteristics

1	Northern Public Transport Interchange + Park and Ride and Western Link - North	• There is currently an interim local board funded PT Hub located at 80 Great North Road. This facility includes:
		  • 137 car parks, including 15 short term and four accessible parking
		  • a bus layover and
		  • bike parking
		• More information on the existing environment is provided in Section 14.

2	Woodcocks Road Upgrade (Western Section)	• The posted speed limit is currently 60 km/h between Mason Heights and Falls Road, the speed limit then becomes unrestricted through the remainder of the rural section.
		• Rural character with two general traffic lanes (one in each direction)
		• Corridor form is consistent, with no kerb and channel on either side of the corridor and no footpaths.
		• Connects to SH1 to the east of the corridor.
		• The latest traffic data for the rural portion of Woodcocks Road was obtained from Auckland Transport. The data was recorded in December 2020 and shows that the corridor has an Average Daily Traffic count of 4,529.
		• Intersections
		  • Woodcocks Road/ Wylie Road - priority controlled intersection.
		  • Woodcocks Road/ Falls Road - priority controlled intersection.
		  • Woodcocks Road/ Mason Heights - no control
		• Currently, no existing walking and cycling facilities along the majority of the corridor.
		• There are no existing bus services on Woodcocks Road.

3	State Highway 1 Upgrade (Southern Section)	• The posted speed limit is currently 100 km/h from the edge of the FUZ to McKinney Road. This changes to 60 km/h through the urban centre between McKinney Road and Woodcocks Road.

NOR	Project	Existing Transport Characteristics

		• Urban character with two general traffic lanes (one in each direction) between Woodcocks Road and Fairwater Road.
		• Rural character with two general traffic lanes (one in each direction) between Fairwater Road and Valerie Close.
		• The latest traffic data for SH1 was obtained from Waka Kotahi. The data was recorded in March 2021 and shows that the corridor has an Average Daily Traffic count of 18,700.
		• Intersections
		  • SH1/ Fairwater Road – priority-controlled intersection
		  • SH1/ Welch Drive – priority-controlled intersection
		  • SH1/ McKinney Road – priority-controlled intersection
		  • SH1/ Toovey Road – no control
		  • SH1/ Valerie Close – priority-controlled intersection
		• Currently, no existing walking and cycling facilities along the rural portion of the corridor extents between Fairwater Road and Valerie Close. There is a footpath on the eastern side of the corridor and on-road cycle lanes on both sides of the corridor between Fairwater Road and Woodcocks Road. The cycle lanes are incredibly narrow and have inconsistent markings to indicate priority.
		• There is one existing service along SH1. The 995 has a service frequency of every 30 minutes during the peak hour.

4	Matakana Road Upgrade	• The posted speed limit is currently 50 km/h between Hill Street and Melwood Drive, the speed limit then becomes 80 km/h through to the edge of the FUZ.
		• Rural character with two general traffic lanes (one in each direction)
		• Connects to Hill Street intersection to the south.
		• The latest traffic data for Matakana Road was obtained from Auckland Transport. The data was recorded in January 2021 and shows that the corridor has an Average Daily Traffic count of 10,000.
		• Intersections
		  • Matakana Road/Te Honohono ki tai Matakana Link Road– roundabout
		  • Matakana Road/ Sandspit Road - priority controlled intersection
		  • Matakana Road/ Melwood Drive – priority-controlled intersection
		  • Matakana Road/ Clayden Road - priority controlled intersection
		• Currently, no existing walking and cycling facilities along the majority of the corridor.
		• There is one existing service along Matakana Road. The 997 has a service frequency of every 2 hours all-day during the weekday.

5	Sandspit Road Upgrade	• The posted speed limit is currently 50 km/h on approach to the Hill Street intersection. This changes to 80 km/h to just after the access road to the Quarry, the speed limit then becomes unrestricted to the end of the FUZ.

NOR	Project	Existing Transport Characteristics

		• Rural character with two general traffic lanes (one in each direction)
		• Corridor form is consistent, with no kerb and channel on either side of the corridor and no footpaths.
		• Connects to SH1 to the west.
		• The latest traffic data for Sandspit Road was obtained from Auckland Transport. The data was recorded in January 2021 and shows that the corridor has an Average Daily Traffic count of 8,215.
		• Intersections
		  • Sandspit Road/ SH1 – signalised intersection
		  • Sandspit Road/ Elizabeth Street – priority-controlled intersection
		  • Sandspit Road/ Millstream Place – priority-controlled intersection
		  • Sandspit Road/ Matakana Road - priority controlled intersection
		  • Sandspit Road/ Withers Lane – no control
		  • Sandspit Road/ Park Lane – no control
		• Currently, no existing walking and cycling facilities along the majority of the corridor.
		• There is one existing service along Sandspit Road. The 996 has a service frequency of every 2 hours all-day during the weekday.

6	Western Link South	• This corridor does not currently exist.
7	Sandspit Link	• This corridor does not currently exist.
8	Wider Western Link - (Northern Section)	• This corridor does not currently exist.

4.2.2 Surrounding Road Network

Several significant roading infrastructure elements are currently under construction or investigation in the Warkworth area. These projects are expected to significantly change transport patterns once they are complete. In particular, the opening of Ara Tūhono and Te Honohono ki Tai is expected to remove traffic from Hill Street a known congestion point particularly in the summer periods and public holidays due to high demand to the east coast settlements.

4.2.2.1 Ara Tūhono – Puhoi to Warkworth

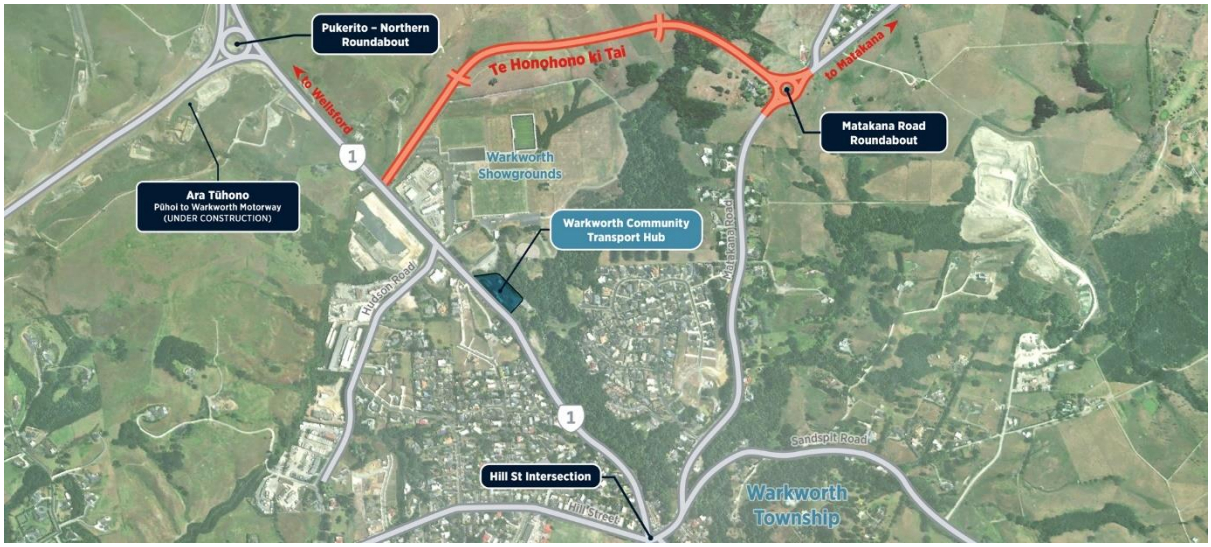
In November 2016, Waka Kotahi NZ Transport Agency awarded a Public Private Partnership (PPP) contract to the Northern Express Group (NX2) to extend the four-lane Northern Motorway (SH1) 18.5km from the Johnstones Hill Tunnels to just north of Warkworth. Under the PPP contract, the NX2 will finance, design, construct, manage and maintain the Pūhoi to Warkworth motorway for the 25 years that will follow the expected six-year period to build the motorway. Full ownership of the highway will remain with the public sector.

The Pūhoi to Warkworth section of Ara Tūhono is expected to open in the second quarter of 2023[7].

4.2.2.2 Te Honohono ki tai – Matakana Link Road

Te Honohono ki Tai is a new 1.3km road connecting Matakana Road and SH1. This project is under construction and will improve the improve the efficiency, resilience and safety of the local transport network including access to and from east coast settlements and beaches. The project is nearing completion and it is understood that the opening will be coordinated with the opening of Ara Tūhono.

Figure 4-4: Tūhonohono ki Tai - Matakana Link Road[8]



4.2.2.3 Hill Street Intersection

The Hill Street intersection has been a significant bottleneck for travellers between Auckland and Northland and for local residents in the Warkworth for a number of years. A Detailed Business Case was completed in 2019, identifying that that intersection would benefit from:

- New cycling and walking facilities
- A five-arm roundabout to improve traffic flow through Brown Road/Great North Road
- A three-arm roundabout to improve traffic flow through the Sandspit Road and Matakana Road intersection.

Detailed design is underway for this intersection and is expected to be completed by early 2023. Subsequent funding for implementation is still to be confirmed but is expected in the short to medium term. An upgrade of the intersection has been included within the SATURN modelling completed.

4.2.2.4 Ara Tūhono – Warkworth to Wellsford

The proposed designation for the second stage of Ara Tūhono – Warkworth to Wellsford was lodged with Auckland Council in April 2020.

[7] https://nx2group.com/

[8] https://at.govt.nz/projects-roadworks/te-honohono-ki-tai-matakana-link-road/

Following this, Auckland Council granted resource consents, and recommended that Waka Kotahi confirm the NOR which occurred in May 2021. Since then, several appeals have been lodged with the Environment Court and this process remains underway.

Given the longer delivery time frame, funding uncertainty and limited influence on the local network within Warkworth, the provision of this extension has not been included within the SATURN modelling completed.

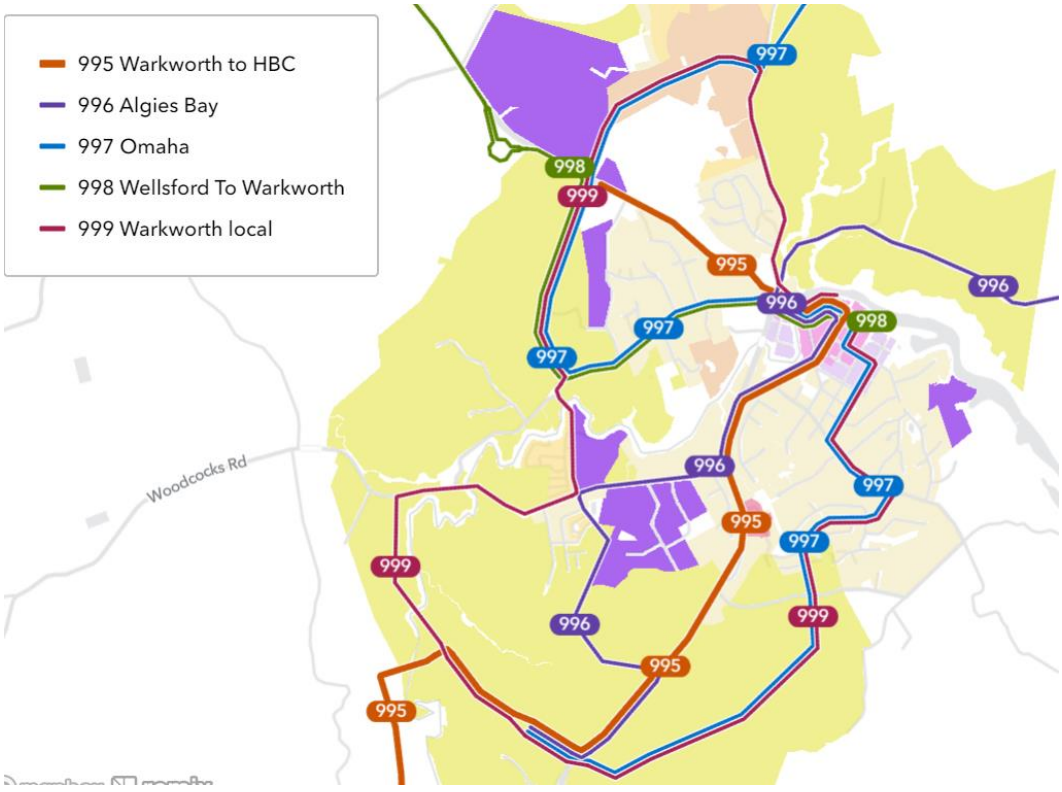
4.2.3 Future Transport Environment

The following table summarises the proposed future transport environment for each of the NoRs. The assessment below has been conducted on the basis that all the corridors in the Warkworth NOR are in place. A general overview for each corridor is also included in the subsequent assessments, including a conceptual cross section.

4.2.3.1 Future Modal Networks

The public transport network has been developed in coordination with Auckland Transport Subject Matter Experts. This indicative network is based on desired levels of service and existing and future expected land use activities.

Figure 4-5: Future Public Transport Network Warkworth

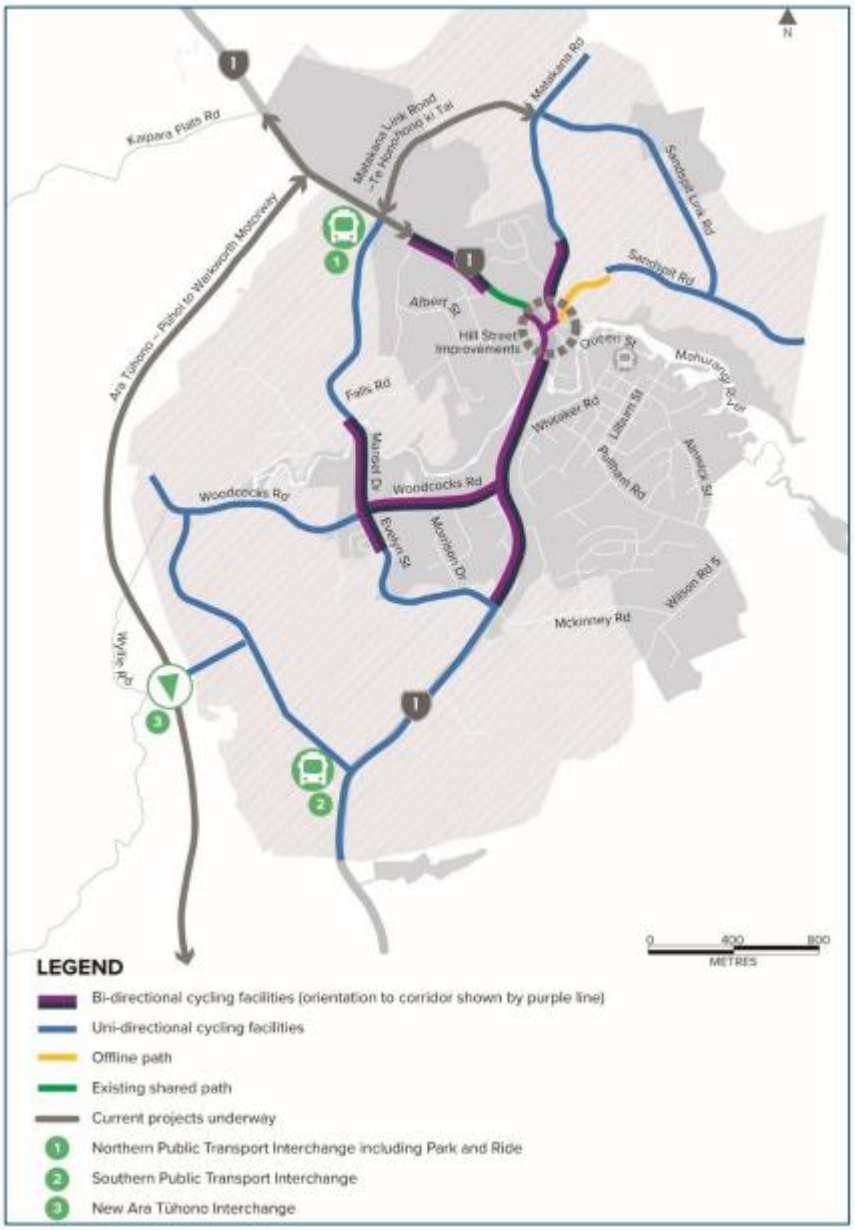


Route #	Route	Week days Headways	
		AM/PM Peak	IP
995	Warkworth to HBC	5 min	15min

Route #	Route	Week days Headways	
		AM/PM Peak	IP
996	Algies Bay to Warkworth	15min	30 min
997	Matakana to Warkworth	15min	30 min
998	Wellsford to Warkworth	15min	30 min
999	Local Warkworth	15min	15 min

In terms of walking and cycling the future network has been developed to enable the proposed NOR projects to integrate with projects that will require the reallocation of road space to upgrade connections. The final network outcome for walking and cycling is shown below in Figure 4-6.

Figure 4-6: Future Walking and Cycling network for Warkworth.



4.2.3.2 Future Environment by Corridor

The following table provides a summary of the future environment as identified by the Warkworth Detailed Business Case, by corridor,

Table 4-3: Future Transport Characteristics for each Notice of Requirement

NOR	Project	Future Transport Characteristics
1	Northern Public Transport Interchange + Park and Ride and Western Link - North	• 50kph speed limit. • Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities. • Connects to SH1 in the north. • Connects to the Northern PT Interchange.

NOR	Project	Future Transport Characteristics

		• The forecast Average Daily Traffic (ADT) in 2048 is 11,600 vehicles on the Western Link North.
		• Intersections
		  • Western Link - North / SH1 – signalised intersection.
		• Cycle lanes and footpaths on both sides.
		• 12 buses forecast as part of the indicative 2048 AT bus network.
		• The Northern PT hub will provide sufficient space to provide:
		  • Four active bus stops
		  • Capacity for at least five services (terminating and through) Note: no reverse movements within the transport hub, so turning facilities to be considered in overall shape and dimensions.
		  • Two layover spaces - includes long distance coaches to Northland.
		  • Kiss and ride drop off facilities.
		  • Bus Driver/Staff facilities to be provided for including a break room and a toilet which could be integrated with public toilets potentially.
		  • Park and Ride for up to 250 spaces
		• Cycle parking integrated/built into buildings/shelters

2	Woodcocks Road Upgrade (Western Section)	• 50kph speed limit.
		• Urban character with two general traffic lanes (one in each direction) and a central median.
		• Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities.
		• Connect to SH1 to the west.
		• Connect to Wider Western Link - North Wider Western Link Western Link to the south.
		• Connect to Western Link to the west.
		• The forecast Average Daily Traffic (ADT) in 2048 is 6,200 vehicles.
		• Intersections
		  • Woodcocks Road/ Wylie Road/ Wider Western Link - North Wider Western Link Western Link – single-lane roundabout
		  • Woodcocks Road/ Falls Road – closed-off
		  • Woodcocks Road/ Mason Heights – priority-controlled intersection
		• Cycle lanes and footpaths on both sides.
		• The indicative 2048 AT bus network forecasts 4 buses during the peak hour.

3	State Highway 1 Upgrade (Southern Section)	• 50kph speed limit. • Urban character with two general traffic lanes (one in each direction) and a central median. • Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities.

NOR	Project	Future Transport Characteristics

		• Connects to the Western Link -South.
		• Connects to the Wider Western Link.
		• The forecast Average Daily Traffic (ADT) in 2048 is 15,400 vehicles.
		  • SH1/ Fairwater Road – signalised intersection
		  • SH1/ Welch Drive – priority-controlled intersection
		  • SH1/ Western Link/ McKinney Road – signalised intersection
		  • SH1/ Toovey Road – priority-controlled intersection
		  • SH1/ Wider Western Link - North Wider Western Link Western Link – single-lane roundabout
		  • SH1/ Valerie Close – priority-controlled intersection
		• Cycle lanes and footpaths on both sides.
		• The indicative 2048 AT bus network forecasts 10 buses during the peak hour.

4	Matakana Road Upgrade	• 50kph speed limit. • Urban character with two general traffic lanes (one in each direction) and a central median • The forecast Average Daily Traffic (ADT) in 2048 is 9,700 vehicles. • Intersections • Cycle lanes and footpaths on both sides, and a bidirectional facility along the southern portion of the corridor. • The indicative 2048 AT bus network forecasts 4 buses during the peak hour.

5	Sandspit Road Upgrade	• 50kph speed limit.
		• Urban character with two general traffic lanes (one in each direction) and a central median.
		• Connect to SH1 to the west.
		• The forecast Average Daily Traffic (ADT) in 2048 is 12,200 vehicles.
		• Intersections
		  • Sandspit Road/ SH1 – single-lane roundabout (Hill Street Improvements – AT)
		  • Sandspit Road/ Elizabeth Street – single-lane roundabout (Hill Street Improvements – AT)
		  • Sandspit Road/ Millstream Place – priority-controlled intersection
		  • Sandspit Road/ Matakana Road – single-lane roundabout (Hill Street Improvements – AT)
		  • Sandspit Road/ Withers Lane – priority-controlled intersection
		  • Sandspit Road/ Park Lane – priority-controlled intersection
		  • Sandspit Road/ Sandspit Link – single-lane roundabout
		• Cycle lanes and footpaths on both sides, and an offline facility between Vipond Culvert and Matakana Road

NOR	Project	Future Transport Characteristics
		• The indicative 2048 AT bus network forecasts 4 buses during the peak hour.

6	Western Link South	• 50kph speed limit.
		• Urban character with two general traffic lanes (one in each direction) and a central median.
		• Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities.
		• Connects to Woodcocks Road in the north.
		• Connects to SH1 in the south.
		• The forecast Average Daily Traffic (ADT) in 2048 is 9,400 vehicles.
		• Intersections
		  • Western Link – South/ Jamie Lane – priority-controlled intersection
		  • Western Link – South/ SH1/ McKinney Road – signalised intersection
		• Cycle lanes and footpaths on both sides.
		• The indicative 2048 AT bus network forecasts 4 buses during the peak hour.

7	Sandspit Link	• 50kph speed limit.
		• Urban character with two general traffic lanes (one in each direction) and a central median.
		• Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities.
		• Connects to Matakana Road in the north.
		• Connects to Sandspit Road in the south.
		• The forecast Average Daily Traffic (ADT) in 2048 is 3,600 vehicles.
		• Intersections
		  • Sandspit Link/ Matakana Road – single-lane roundabout
		  • Sandspit Link/ Sandspit Road – single-lane roundabout
		• Cycle lanes and footpaths on both sides.
		• No buses forecast as part of the indicative 2048 AT bus network.

8	Wider Western Link - (Northern Section)	• 50kph speed limit. • Urban character with two general traffic lanes (one in each direction) and a central median. • Consistent corridor form with kerb and channels on both sides and continuous footpaths and cycle facilities. • Connects to Woodcocks Road in the north. • Connects to SH1 in the south. • The forecast Average Daily Traffic (ADT) in 2048 is 6,100 vehicles. • Intersections • Wider Western Link/ Woodcocks Road/ Wylie Road – single-lane roundabout

NOR	Project	Future Transport Characteristics
		• Wider Western Link/ Link to Southern Interchange – single-lane roundabout • Cycle lanes and footpaths on both sides. • The indicative 2048 AT bus network forecasts 4 buses during the peak hour.

4.2.3.3 Ara Tūhono Southern Interchange

An additional motorway interchange with Ara Tūhono was identified by the Warkworth Detailed Business Case. This interchange provides south facing ramps to the Ara Tūhono motorway. The interchange provides additional access to the proposed industrial area in the southern growth area.

The proposed interchange has the opportunity to redistribute traffic across the Warkworth network, and as such commentary has been provided for each NOR below on the potential traffic effects with the Southern Interchange in place and without this infrastructure in place.

The southern interchange is not included within the Warkworth Package as concept designs indicate that sufficient land is available within existing Waka Kotahi designation and/or Waka Kotahi owned land.

4.2.3.4 Southern Public Transport Interchange

In order to support the expected growth in the southern part of Warkworth, a second public transport interchange is proposed in Warkworth Detailed Business Case. This public transport interchange would provide local catchment to public transport services, and in the longer term will connect to the new proposed Ara Tūhono interchange, providing access to the strategic network for longer distance commuters.

The best transport outcomes for this Public Transport interchange require a location integrated with the surrounding land uses. While the Structure Plan provides an indicative local centre location, the current future urban zoning results in a high degree of land use uncertainty. As such, the Southern PT interchange is not proposed to be designated as part the Warkworth package at this stage.

4.2.3.5 Other Future Corridor Upgrades

The full Warkworth network as identified in the Warkworth Detailed Business also identified a series of projects that include upgrades to existing roads and new roads. These are not subject to designations as part of the Warkworth package but will enable connections from the eight Warkworth NoRs. These include:

- Existing Road Upgrades to the following corridors within the road reserve primarily improving walking and cycling facilities.
  - Western Link Central
  - Woodcocks Road North:
  - State Highway 1 (North of Fairwater Avenue)
- New Arterial Roads
  - Western Link North: South of the PT Hub interface this corridor is proposed to be delivered by developers. The alignment and components of the corridor including walking and cycling and sufficient setback for future public transport priority measures are provide for within the provisions in the Warkworth North Precinct.

- Wider Western Link South: South of the crossing of the Mahurangi crossing, the Wider Western Link is likely to be enabled via Plan Change mechanisms.

- Interchanges
  - Southern PT Hub likely to be enabled via Plan Change mechanisms.
  - South facing ramps on Ara Tūhono – sufficient land holdings present to enable a connection in the future.

4.2.4 Future Transport Environment without the Projects

The following table has been prepared to summarise the transport implications in the case that the each respective NOR, and subsequently the project, does not proceed. This also provides some assessment of the interdependencies between the proposed NORs, with additional information provided under each NOR assessment further in this report.

4.2.4.1 Road Safety

The following table provides an assessment of the road safety implications for each corridor should the NOR / Project not proceed.

Table 4-4: Road Safety Effects without the NOR for each Project

Proposed NOR	Road Safety Effect if the NOR does not proceed
Northern Public Transport Interchange + Park and Ride and Western Link - North	Western Link is a new corridor from State Highway 1, that will in the longer term connect with Falls Road. From a road safety perspective, without the Project additional pressure will be placed on the existing network, in particular on State Highway 1 and Falls Road. Falls Road is a local road and provides access to residential properties and access to Warkworth Primary School. Increased vehicle movements on this corridor will increase exposure to potential conflict for vulnerable road users.
Woodcocks Road Upgrade (Western Section)	The existing Woodcocks Road is not fit for purpose to support the planned future urban growth, due to the high-speed environment, narrow carriageway, and significant increase in conflicts between through traffic, accessing/turning movements and vulnerable road users. These increases in conflicts will lead to increases in DSIs[9] The expected increase in safety issues is also likely to constrain the attractiveness of walking and cycling, further reinforcing use of vehicles with the resulting high-speed conflicts. Although the speed limit could be reduced, as a safety improvement measure, the existing Woodcocks Road will remain unsafe to safely accommodate future growth due to the type and number of conflicts expected. It is also noted that the Woodcocks Road NOR also provides for the replacement of a one-way bridge. Without the replacement of this bridge increased traffic volumes at this location poses an increased safety risk.
State Highway 1 Upgrade (Southern Section)	The existing State Highway 1 is not fit for purpose to support the planned future urban growth, due to the high-speed environment, narrow carriageway, and significant increase in conflicts between through traffic, accessing/turning movements and vulnerable road users. These increases in conflicts will lead to increases in DSIs. The southern section of State Highway 1 is consistent with a higher speed rural state highway and in order to support the corridor to function as an urban arterial, infrastructure change is needed in particular to support active modes to travel along the corridor.

[9] Death and Serious Injury Crashes

Proposed NOR	Road Safety Effect if the NOR does not proceed
	The expected increase in safety issues is also likely to constrain the attractiveness of walking and cycling, further reinforcing use of vehicles with the resulting high-speed conflicts.
Matakana Road Upgrade	The existing Matakana Road is not fit for purpose to support the planned future urban growth, due to the high-speed environment, narrow carriageway, and significant increase in conflicts between through traffic, accessing/turning movements and vulnerable road users. These increases in conflicts will lead to increases in DSIs. The expected increase in safety issues is also likely to constrain the attractiveness of walking and cycling, further reinforcing use of vehicles with the resulting high-speed conflicts. This is considered particularly relevant for this corridor given the proximity to the Warkworth Town Centre and the new developing areas surrounding Te honohono ki Tai.
Sandspit Road Upgrade	The existing Sandspit Road is not fit for purpose to support the planned future urban growth, due to the high-speed environment, narrow carriageway, and significant increase in conflicts between through traffic, accessing/turning movements and vulnerable road users. These increases in conflicts will lead to increases in DSIs. The expected increase in safety issues is also likely to constrain the attractiveness of walking and cycling, further reinforcing use of vehicles with the resulting high-speed conflicts. Although the speed limit could be reduced, as a safety improvement measure, the existing Sandspit Road will remain unsafe to safely accommodate future growth due to the type and number of conflicts expected. It is also noted that there is very limited sealed shoulders on this corridor, resulting in high levels of conflict within the road corridor.
Western Link South	Western Link South is an extension of Evelyn Street through to State Highway 1. From a road safety perspective, without the Project additional pressure will be placed on the existing network, in particular on Woodcocks Road and State Highway 1. These corridors and their appropriateness to accommodate growth from a road safety perspective are discussed under each respective corridor.
Sandspit Link	Sandspit Link is a new corridor from Woodcocks Road to State Highway. From a road safety perspective, without the Project additional pressure will be placed on the existing network, in particular on Matakana Road and Sandspit Road. These corridors and their appropriateness to accommodate growth from a road safety perspective are discussed under each respective corridor.
Wider Western Link - North	Wider Western Link is a new corridor from Woodcocks Road to State Highway 1. From a road safety perspective, without the Project additional pressure will be placed on the existing network, in particular on Woodcocks Road and State Highway 1. These corridors and their appropriateness to accommodate growth from a road safety perspective are discussed under each respective corridor.

4.2.4.2 Walking and Cycling

An assessment of walking and cycling outcomes without each NOR has been provided below in Table 4-6. This assessment considers that the existing facilities form the basis of the do minimum network. In the case of new arterial connections, the assessment considered existing alternatives that are in place and the outcomes for walking and cycling should alternative corridors be utilised.

Overall, walking and cycling demands are expected to significantly increase as a result of the expected growth. A summary of the expected active mode demands derived from the Strategic Active Mode Model is summarised below in Table 4-5.

Table 4-5: Predicted Walking and Cycling Daily trips in Warkworth

Number of Daily Active Mode Trips without NORS in place	Number of Active Mode Trips with NORS in Place
1,086 trips or 10% daily active mode share	1,633 trips or 15% of daily active mode share

Given that finer grain networks, including collector and local roads that are still in development, provision of these demands on an area basis is considered to be appropriate and can provide an indication of level of likely demands with the Projects in place.

Potential demand with the Projects in place is considered to reflect likely demand for facilities, without the suppression of active mode trips that occurs without the NORS (and supporting networks) due to absence facilities or facilities that have a low quality of service for users.

Table 4-6: Walking and Cycling Effects without the NOR for each Project

Proposed NOR	Existing Active Mode Facilities	Walking and Cycling Effect if the NOR does not proceed
Northern Public Transport Interchange + Park and Ride and Western Link - North	New Corridor	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. In particular this corridor links to a new Local Centre, which includes significant employment, recreational and social infrastructure. • This corridor will provide walking and cycling access to the Northern PT Hub. Without the connection access to the PT hub will be significantly lower, reducing walking and cycling catchment opportunities.
Woodcocks Road Upgrade (Western Section)	Currently no facilities	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. • In particular this includes access to Mahurangi College, and access to employment opportunities at the eastern extent of Woodcocks Road.
State Highway 1 Upgrade	Currently no facilities	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses.

Proposed NOR	Existing Active Mode Facilities	Walking and Cycling Effect if the NOR does not proceed
(Southern Section)		• In particular this corridor links to the Warkworth Town Centre in the north, which includes significant employment, recreational and social infrastructure. • Access south to a new local centre, including a southern Public transport interchange will be compromised. • Access to Mahurangi College at the intersection of Woodcocks Road and SH1 by walking and cycling will be impacted, reinforcing private vehicle mode choice.
Matakana Road Upgrade	Section of footpath between Melwood Drive and Hill Street intersection	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. • In particular this corridor links to the Warkworth Town Centre, which includes significant employment, recreational and social infrastructure.
Sandspit Road Upgrade	Currently no facilities	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. • In particular this corridor links to the Warkworth Town Centre, which includes significant employment, recreational and social infrastructure.
Western Link South	New Corridor	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. In particular this corridor links to the employment opportunities and provides a north/south link through the proposed growth area. • Without this corridor in place walking and cycling connectivity will be via the local and collector network and will likely be less direct, resulting in longer travel times for pedestrians and cyclists.
Sandspit Link	New Corridor	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. In particular this corridor provides a link through the north eastern proposed growth area. • Without this corridor in place walking and cycling connectivity will be via the local and collector network and will likely be less direct, resulting in longer travel times for pedestrians and cyclists. This is particularly key for this corridor given the stream environment and topography.
Wider Western Link - North	New Corridor	• Access to employment and social amenities will be compromised, especially for immediately adjacent land uses. In particular this corridor links to the employment opportunities and provides a north/south link through the southern proposed growth area. • Without this corridor in place walking and cycling connectivity will be via the local and collector network and will likely be less

Proposed NOR	Existing Active Mode Facilities	Walking and Cycling Effect if the NOR does not proceed
		direct, resulting in longer travel times for pedestrians and cyclists. • This link provides a direct connection between Woodcocks Road and the proposed local centre adjacent to SH1. This corridor will provide an legible, efficient route for pedestrians and cyclists.

4.2.4.3 Public Transport

In terms of public transport the most significant change to the public transport environment in Warkworth is the provision of the Northern Public Transport Interchange and Park and Ride.

Without this NOR in place the following public transport impacts are expected:

- Increased congestion in the Warkworth Town centre with limited available space for layovers or charging. This will result in network frequencies being limited in response to available capacity.
- Insufficient capacity at the interim park and ride at Warkworth will result in increased on street all day parking, which will impact on local business and street amenity. Future demands for park and ride facilities are predicted to be some 250 spaces, 120 spaces greater than the interim facility. There will also be an increase in 'hide and ride' parking behaviour where commuters utilise local streets to park and utilise more frequent bus services.
- Public transport network interchanges will be limited to the Warkworth town centre, and with limited space, this will make quick and efficient interchanges difficult.
- Additional bus vehicle lanes can be provided within the proposed NOR for the Western Link North. Without this opportunity, buses will mingle with the general traffic and will have reduce efficiency accessing the PT Hub.

Further information is provided in Section 6.

4.2.4.4 General Traffic

The following table provides a summary of the expected traffic volumes on the transport network in 2048+ both without and with the NORS / Projects, together with an assessment of the outcomes expected to arise in the case that each NOR does not proceed.

In the case of new corridors, the traffic effects of a new corridor not being implemented is largely on the existing road network. At an area-level, the growth areas has been assessed to consider the vehicle to capacity ratios. At a network-level, it can be seen that the overall transport effects for traffic are acceptable. These results are summarised below.

Table 4-7: Vehicle KM in Peak Congestion

	Vehicle Km Travelled in peak congestion (>90% v/c) in AM peak (no NORs) in 2048+	Vehicle Km Travelled in peak congestion (>90% v/c) in AM peak (with NORs) in 2048+
Network Performance	475 vehicle-km travelled in congested conditions	185 vehicle- km travelled in congested conditions

In addition to this, for all intersections Auckland Transport and Waka Kotahi (where applicable) will manage the network to achieve and balance a range of outcomes, including traffic efficiency, user safety (for all modes), and prioritising movement by more sustainable modes, such as public transport and active modes. This shift from a singular focus on traffic delay to broader outcomes and prioritisation of more sustainable movements is ongoing and driven by regional and national policy directives. This includes recent policy direction around reallocating road space to favour these broader outcomes, where practicable. Collectively, this requires a broader assessment of needs and priorities of the transport system than just localised vehicle delays at selected intersections. Notwithstanding this, intersection performance is provided per NOR further in this report.

Mode shift towards public transport is a key outcome of the overall Warkworth network packages, and modal priorities are expected to change with less priority given to general traffic flow. In this regard, the future operating environment is anticipated to tolerate increased delay and queuing for general traffic, at certain intersections, at certain times.

Table 4-8: General Traffic and Freight Effects without the NOR for each Project

Proposed NOR	Without the NOR in 2048+	With the NORS in 2048+	General Traffic and Freight Effect if the NOR does not proceed
Northern Public Transport Interchange + Park and Ride and Western Link - North	New Corridor	The forecast Average Daily Traffic (ADT) in 2048 is 11,600 vehicles.	As growth increases in the area the current lack of an arterial network will reduce connectivity and result in a heavy reliance on the existing network around Warkworth. Without an arterial network, there will be an increasing reliance on the local and collector network. This will result in longer, less efficient bus networks, and safe cycle connections on desire lines would be limited. Without providing for through movement functions on arterials, there will likely be an increase in traffic utilising lower order corridors such as local and collector roads, with potential adverse effects on amenity and capacity. The Western Link - North is a key link as part of the Western Link Route. The route provides an alternative north-south connection to SH1 on the Warkworth transport network. Without this corridor, there will be a substantial increase in traffic volumes along SH1. This is significant as SH1 will remain a two-lane corridor in the future, resulting in a corridor that is at capacity, and provides poor levels of

Proposed NOR	Without the NOR in 2048+	With the NORS in 2048+	General Traffic and Freight Effect if the NOR does not proceed
			service for general traffic and freight accessing the corridor.
Woodcocks Road Upgrade (Western Section)	The forecast Average Daily Traffic (ADT) in 2048 is 7,000 vehicles.	The forecast Average Daily Traffic (ADT) in 2048 is 6,200 vehicles.	There is little effect from a general traffic outcome should the Project not proceed. Expected traffic volumes with and without the NOR are similar and no additional capacity to that existing is proposed.
State Highway 1 Upgrade (Southern Section)	The forecast Average Daily Traffic (ADT) in 2048 is 17,800 vehicles.	The forecast Average Daily Traffic (ADT) in 2048 is 15,400 vehicles.	There is little effect from a general traffic outcome should the Project not proceed. Expected traffic volumes with and without the NOR are similar and no additional capacity to that existing is proposed.
Matakana Road Upgrade	The forecast Average Daily Traffic (ADT) in 2048 is 11,100 vehicles.	The forecast Average Daily Traffic (ADT) in 2048 is 9,700 vehicles.	There is little effect from a general traffic outcome should the Project not proceed. Expected traffic volumes with and without the NOR are similar and no additional capacity to that existing is proposed.
Sandspit Road Upgrade	The forecast Average Daily Traffic (ADT) in 2048 is 15,100	The forecast Average Daily Traffic (ADT) in 2048 is 12,200	There is little effect from a general traffic outcome should the Project not proceed. Expected traffic volumes with and without the NOR are similar and no additional capacity to that existing is proposed.
Western Link South	New Corridor	The forecast Average Daily Traffic (ADT) in 2048 is 9,400 vehicles.	As growth increases in the area the current lack of an arterial network will reduce connectivity and result in a heavy reliance on the existing network around Warkworth. Without an arterial network, there will be an increasing reliance on the local and collector network. This will result in longer, less efficient bus networks, and safe cycle connections on desire lines would be limited. Without providing for through movement functions on arterials, there will likely be an increase in traffic utilising lower order corridors such as local and collector roads, with potential adverse effects on amenity and capacity. The Western Link South is a key link as part of the Western Link Route. The route provides an alternative north-south connection to SH1 on the Warkworth transport network. Without this corridor, there will be a substantial increase in traffic volumes along SH1. This is significant as SH1 will remain a two-lane corridor in the future, resulting in a corridor that is at capacity, and provides poor levels of

Proposed NOR	Without the NOR in 2048+	With the NORS in 2048+	General Traffic and Freight Effect if the NOR does not proceed
			service for general traffic and freight accessing the corridor.
Sandspit Link	New Corridor	The forecast Average Daily Traffic (ADT) in 2048 is 3,600 vehicles.	As growth increases in the area the current lack of an arterial network will reduce connectivity and result in a heavy reliance on the existing network around Warkworth. Without an arterial network, there will be an increasing reliance on the local and collector network. This will result in longer, less efficient bus networks, and safe cycle connections on desire lines would be limited. Without providing for through movement functions on arterials, there will likely be an increase in traffic utilising lower order corridors such as local and collector roads, with potential adverse effects on amenity and capacity. While not part of the Warkworth package, the Hill Street improvements will be impacted by the timing of the Sandspit Link. An additional benefit of this new connection is to allow trips to and from the Kowhai Coast settlements to reach Matakana and the strategic network without the need to travel through Hill Street Intersection. Without Sandspit Link, the proportion of traffic travelling through the Hills Street intersection will increase significantly. This is likely to have an adverse effect on general traffic and freight due to increased congestion and delays.
Wider Western Link - North	New Corridor	The forecast Average Daily Traffic (ADT) in 2048 is 6,100 vehicles.	As growth increases in the area the current lack of an arterial network will reduce connectivity and result in a heavy reliance on the existing network around Warkworth. Without an arterial network, there will be an increasing reliance on the local and collector network. This will result in longer, less efficient bus networks, and safe cycle connections on desire lines would be limited. Without providing for through movement functions on arterials, there will likely be an increase in traffic utilising lower order corridors such as local and collector roads, with potential adverse effects on amenity and capacity. The Wider Western Link is linked to the Southern Interchange with Ara Tūhono. Accordingly, the Southern Interchange, will not be able to be provided until such time that that Wider Western Link is in place, to provide access to the interchange. Therefore without the Wider Western Link in place, traffic will shift to SH1, in particular freight from adjacent industrial areas that need to access Ara Tūhono. The increased traffic volumes on SH1is significant as SH1 will

Proposed NOR	Without the NOR in 2048+	With the NORS in 2048+	General Traffic and Freight Effect if the NOR does not proceed
			remain a two-lane corridor in the future, resulting in a corridor that is at capacity, and provides poor levels of service for general traffic and freight accessing the corridor.

4.2.4.5 Property Access

Without the provision of each respective NOR there is expected to be no change to the existing access provisions for properties that gain access from the corridors.

4.2.4.6 Wider Network Effects

This is discussed under each respective NoR.

5 Warkworth NORS – Overall network

This section assesses common or general transport matters across the overall Warkworth Project i.e. the combination of public transport interchanges, existing road upgrades and new corridors. This section also recommends measures to avoid, remedy, or mitigate actual or potential adverse effects for the overall network. Matters unique or specific to each NOR are in subsequent chapters, in particular Sections 6 to 13.

5.1 Assessment of Positive Effects

5.1.1 Overall Positive Network Effects

Overall, the Warkworth Detailed Business Case identified a network that provides for a comprehensive transport solution that responds to planned growth. It is noted that this ITA considers these projects as a network and has an overall focus on the outcomes for the Warkworth area. The NORS are all proposed as separate projects and can be implemented progressively in coordination with progressive land use development.

The eight notices of requirement identified in this ITA are a core component of this network, with the proposed projects supporting the following transport outcomes:

- Long term development of a low carbon transport system to support future growth and facilitates mode shift from private vehicles to public transport and active modes to reduce greenhouse gas emissions.
- People living and working in Warkworth as part of the Satellite Town vision with direct freight connections to planned industrial land use and improved access to employment and social amenities.
- Transport corridors to maximise opportunities for walk up catchments to public transport interchanges and a high frequency local bus network.
- Increased reliability for public transport and additional resilience via urbanised alternative routes.
- Real travel choice with high quality, attractive alternatives to the private vehicle. This includes a contiguous, legible active mode network that connects people to key destinations and encourages active mode trips within the compact urban area.
- An area wide focus on safety through a holistic set of measures including Road to Zero safety principles, fully separated cycling facilities, well designed intersections and sufficient space for all modes to interact safely.

5.1.2 Walking and Cycling

The majority of the projects indicatively propose separated walking and cycling facilities on both sides of the corridor, which connect with expected future adjacent facilities. There are some corridors indicatively proposed to have alternative facilities for walking and cycling due to environmental and engineering constraints. These include:

- Sandspit Road – a shared offline boardwalk path adjacent to Sandspit Road from Vipond Culvert to Matakana Road integrating with facilities at the Hill Street intersection (not within scope of NOR 5)
- Matakana Road – a bidirectional cycle facility to integrate with the Hill Street Intersection walking and cycling infrastructure (not within scope of NOR 4)

- State Highway 1 – a bidirectional cycling facility from Woodcocks Road to McKinney Road, which will integrate with the State Highway 1 facilities and intersection improvements at Woodcocks Road (not within this scope of NOR 3)

These variations remain consistent with the objectives of Auckland Transport Vision Zero and comply with AT Transport Design Manual Standards.

The proposed walking and cycling facilities have been designed in accordance with relevant AT standards and policies as summarised in Table 5-1.

Table 5-1: Walking and Cycling AT Standards and Policies for the Walking and Cycling Upgrades

Policy/Standard	Network Component	Assessment
Auckland Transport Vision Zero[10]	Segregated walking and cycling facilities	Segregated walking and cycling facilities are proposed to provide a safe modal choice in the future environment. Vision Zero specifies that indicative proposed designs should feature separated cycling facilities for arterial corridors in excess of 30km/hr. The traffic speeds on the corridor are proposed to be 50km/hr, therefore the indicative proposed design of the walking and cycling facilities is considered to be appropriate for these standards.
AT Transport Design Manual[11]	Segregated walking and cycling facilities	A 1.8m footpath is has been allowed for on all corridors and a 2.0m cycle path. The total width of 6.8m is provided from carriageway to road boundary. This is in accordance with the AT TDM requirements.
	Offline paths	A section of Sandspit Road is proposed to include a boardwalk walk that is indicatively 5.0m wide. This complies with the AT TDM requirements.
	Bidirectional cycle facilities	A section of Matakana Road and State Highway 1 is indicatively proposed to have bidirectional cycle facilities. This are indicatively shown as approximately 4.0m wide. This complies with the AT TDM requirements.

Exact provision of walking and cycling crossing facilities will be confirmed at the detailed design stage and will be guided by Vision Zero guidance.

Overall, the projects will have a number of significant positive effects on walking and cycling as they will:

- Significantly reduce the likelihood and exposure to potential crashes as it will enable safe movement for vulnerable road users along and across the corridor.
- Improve integration with the future walking and cycling network, resulting in improved east-west and north-south walking and cycling connectivity.
- Lead to environmental and health benefits as a result of increased active mode trips and reduced reliance on vehicle trips.
- Support growth adjacent to the corridor and significantly improve safety and access to employment and social amenities.

[10] Auckland Transport: Vision Zero: https://at.govt.nz/media/1980910/vision-zero-for-tamaki-makaurau-compressed.pdf
[11] Auckland Transport – Transport Design Manual: https://at.govt.nz/about-us/manuals-guidelines/roads-and-streetsframework-and-the-transport-design-manual/

5.1.3 Public Transport

Overall, is anticipated that the expected growth in Warkworth will be supported by incremental improvements in public transport services. This includes the provision of new public transport routes, and increased frequency on existing routes. This improved public transport offering is necessary to support a shift to alternative modes and increase the attractiveness of public transport as a mode choice.

The increased public transport services are predominantly operational, and for NOR 2 through to NOR 8, there are no specific components of the designation to enable infrastructure-based measures in the carriageway such as bus lanes or bus priority measures at intersections. Sufficient capacity is expected within the intersections and vehicle lanes of these projects, and as such dedicated facilities are not warranted. Sufficient berm space has also been allocated along the corridors to facilitate bus shelters and bus stops.

NOR 1: Northern PT Hub includes sufficient corridor width to enable public transport priority lanes if necessary and also provides for the designation for the PT Hub itself – this is discussed further in Section 6.

A summary of these increased service frequencies provided below in Table 5-2.

Table 5-2: Future Public Transport Services

NoR	Corridor	Proposed Bus Service Levels
1	Western Link North and PT Hub	See Section 6.4.1 for more detail.
2	Woodcocks Road Upgrade (Western Section)	One core proposed frequent bus service which will use this portion of Woodcocks Road. This service is forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.
3	State Highway 1 Upgrade (Southern Section)	For future public transport services, there are two core proposed frequent bus services which will use this portion of SH1. The first service (995) is forecast to operate every 10 minutes in the peak commute hours, and every 15 minutes outside of the peak. The second service (996) is forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.
4	Matakana Road Upgrade	For future public transport services, there is one core proposed frequent bus service which will use this portion of Matakana Road. This service is forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.
5	Sandspit Road Upgrade	For future public transport services, there is one core proposed frequent bus service which will use this portion of Sandspit Road. This service is forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.
6	Western Link South	For future public transport services there is one core proposed frequent bus service which will use the Western Link - South. This service is

NoR	Corridor	Proposed Bus Service Levels
		forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.
7	Sandspit Link	For future public transport services, no bus routes proposed under indicative 2048 AT bus network along the Sandspit Link. However, the cross-section will provide adequate spacing to facilitate public transport and associated bus stops if bus services are proposed in the future.
8	Wider Western Link - North	For future public transport services there is one core proposed frequent bus service which will use the Northern portion of the Wider Western Link. This service is forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.

The proposed indicative cross-section provides adequate spacing to facilitate public transport and associated bus stops. The exact location of bus stops will be identified as part of detailed design for the project. Once greater certainty is available on the location of key land use activities, more certainty on high demand locations for bus stops can be determined, i.e. around centres and schools for example.

The positive operational effects on public transport for the above corridors are:

- Improved accessibility for future frequent public transport network
- Improved integration with the future public transport network and improved east-west connectivity, as well as improved access to employment and social amenities.
- Increased attractiveness and uptake of public transport trips which will reduce reliance on vehicle trips, resulting in positive environmental and health benefits.

Specific public transport effects related to NOR 8 is provided in Section 14.

5.1.4 Safety

The design of all projects have been undertaken with consideration of the latest safety guidance. This includes AT's Vision Zero and Waka Kotahi's Road to Zero. The new corridor is expected to result in positive effects on safety due to the:

- New, walking and cycling facilities (including separation), resulting in improved protection for vulnerable road users.
- New, walking and cycling crossing facilities (crossing the arterial) and at key intersections, resulting in a significantly safer environment for all road users.
- Appropriate urban speeds (e.g. 50km/h) and consequential reductions in the risk of Death or Serious Injuries (**DSIs**).

It is anticipated walking and cycling demands will increase significantly as the area urbanises and develops. Given the expected traffic volumes along the corridors, there will be a safety risk for active mode users travelling along the corridor without appropriate facilities. Therefore, the project has been designed to 50km/h posted speed and provides segregated walking and cycling facilities to reduce the likelihood and severity in the event of a crash.

Existing crash records have been provided in Appendix 2. Itis critical to note that while this information has been provided, consideration should be given to several key matters when considering the relevance of this historic data to the future environment:

- An objective of each of the NORS is to support a safe transport network for all users. This is reflected in the indicative design with proposed designation footprint sufficient to deliver this.
- The context of the surrounding land use in these areas. In particular Warkworth growth area for the five years assessed has been a mix of rural, transitioning rural to urban and urban. Accordingly, the roading network reflects these changes, with some roads changing from urban to rural within the time period, and others predicted to change in the future
- Speed limit bylaw changes. Several key corridors have been subject to speed reductions as part of rolling safety initiatives implemented by Auckland Transport and Waka Kotahi
- The crash records are reflective of the current transport demand on these corridors. In general, current active mode (walking and cycling) use of these corridors is very low (due to the lack of safe and attractive facilities).
- At a regional level in Auckland between 2014 and 2020, 57% of all fatalities were people travelling outside vehicles (pedestrians 27%; cyclists 8.1%; motorcyclists 21.6%). Although it is difficult to get a clear trend from 2020 data due to Covid-19 lockdowns and incomplete finalising of reporting, there does not appear to have been any notable improvements to the relative safety of Vulnerable Transport Users on foot, bike and motorcycle since 2017, while there has been some improvement to the DSI for people inside motor vehicles[12].
- The count data from CAS also significantly underplays the true extent of serious harm to transport users outside motor vehicles, as identified by Ministry of Health hospital data.[13]

Overall, the indicative proposed design is well aligned with the transport safety principles from AT and Waka Kotahi. It will provide a safe transport corridor and reduce the risk of a DSI occurring, resulting in positive effects for all road users.

It is noted that the prior to implementation of the projects, further detailed design will be completed to confirm the walking and cycling facilities that will be provided. Accurate projections of DSI reductions require confirmation of the detailed design and an understanding of demands and certainty of landuse activities. As such, for the purpose of designation and footprint allocation, the approach of provision of segregated facilities compliant with the Auckland Transport Design Manual is considered appropriate and will maximise positive safety outcomes.

5.2 Assessment of Construction Effects

5.2.1 Construction Effects Related to All NORs

It is anticipated that the larger part of works required for this package of projects will likely be adjacent to or in the live carriageway, which means that temporary traffic management will be required. The scale of temporary traffic management to delineate live traffic away from the construction zones is largely dependent on the various stages and requirements of the construction activities. It is expected that short term temporary road closure for nights or weekends may be required for some specific activities, such as road surfacing, traffic switches and gas relocation. Other activities may require

[12] https://at.govt.nz/media/1986346/2021-report-on-auckland-road-safety-bir-2018-recommendations-implementation-final.pdf
[13] ViaStrada VRU Study, 2021

stop/go or contraflow traffic management, such as drainage, utility relocation, survey and investigation work.

The effect of temporary road closure or other traffic management methods to existing traffic on the specific corridor and adjacent road network should be confirmed in the future as part of the CTMP for each project on the basis of the current traffic environment. This will take into account the level of growth and activities that has occurred in Warkworth, the availability of the alternative routes, and any additional sensitive land use activities.

The construction of the projects will each likely require significant earthworks. Final cut and fill volumes will be confirmed following detailed design prior to construction. The construction traffic movements to accommodate the earthworks will likely result in the increase of traffic volumes on construction routes used during the construction period of each of the projects.

Given the construction timing and staging of the package has yet to be determined, there is a degree of uncertainty associated with any predicted construction methodology and associated traffic routes. This means:

- The routes that will be used by construction vehicles will depend on the location of quarries and disposal sites which are not yet certain.
- The exact location and extent of compound sites/lay down areas has yet to be determined.
- The timing of construction of other projects could impact on likely construction vehicle routes, for example, if the Wider Western Link – (Northern Section) is constructed prior or after to the upgrade of Woodcocks Road.

Notwithstanding this, it is considered that with available connectivity to the strategic network and available capacity in the network, construction traffic will be able to be readily accommodated.

It is noted that the access to compound sites/laydown areas and construction zone for construction vehicles, plant and materials will be via site access points identified as part of future CTMPs.

Details of the routes and time restrictions will need to be updated and refined as part of the CTMP process. It is anticipated that the routes for construction traffic will likely be limited to arterial corridors and intersections with the provision of adequate vehicle tracking. With State Highway 1 (SH1) as a Level 1A freight route, it is recommended that this corridor is used where practicable.

Speed Limits

In order to maintain the safety of all road users, it is recommended to implement a safe and appropriate temporary speed limit during the construction period on the network within the extent of works, and along the construction routes if needed. This should be in accordance with the latest traffic management standards at the time of construction. These recommended measures and other measures highlighted in the CTMP are expected to reduce the potential safety risks that may be associated with construction traffic.

Pedestrians and cyclists

The existing provision for pedestrian and cyclists is variable across the network. It is likely that the demand for these modes will increase if urbanisation occurs prior to construction, but future parallel collectors could also be used as alternative routes. Therefore, effects should be assessed again when a greater level of detail is available about surrounding facilities and land use activities prior to

construction. However, it is recommended that residents and stakeholders be kept informed of construction times and progress, and general observations of pedestrian and cyclist activity be used to inform appropriate traffic management measures in the CTMP.

Property access for residents and businesses

During the time of construction, there will be temporary traffic management controls such as temporary concrete or steel barriers. Existing driveways that remain during construction will be required to have temporary access provision. It is anticipated that the contractor should undertake a property specific assessment of any affected driveways and provide temporary access arrangements if required. The temporary access should ensure the ability for residents to safely access and exit the property. These requirements should be captured in the CTMP or SSTMP, if required. It is noted that significant land use change is expected along these key arterials, for example The Grange centre on SH1. As such, confirmation of traffic management controls will be required immediately prior to works to reflect the land use considerations at that time.

Construction Movements - Timing

Warkworth is located in proximity to the State Highway network and also in proximity to very popular recreational areas for the wider Auckland Area. The area currently experiences significant congestion in peak periods such as public holiday weekends and over the Christmas/New Year period.

As such, the development of the CTMP prior to construction of any of the projects will need to consider the implications on construction movements through the Hill Street Intersection. The CTMP will need to consider if the Hill Street intersection has been upgraded as planned, the performance of the intersection post opening of Ara Tūhono and Tūhonohono ki Tai and construction movement timings in peak periods including holiday periods. A specific condition is as such recommended to require these considerations once implementation timing and likely construction routes are confirmed.

Land use activities that will need further consideration in the CTMP

The following table provides a summary of the key land use or activities that are located adjacent to the corridors and will need consideration during the development of the CTMP. This could include restricted truck movements during school pick up and drop off, or additional controls at key access locations. The below is not a final or complete list, with land use changes likely, this list will change over time.

Table 5-3: Sites for Consideration within future CTMP

Corridor	NOR	Sites for Specific Consideration
Northern Public Transport Interchange + Park and Ride and Western Link - North	1	• No specific sites identified
Woodcocks Road Upgrade (Western Section)	2	• Mahurangi College • New MOE school site at 100 Woodcocks Road

Corridor	NOR	Sites for Specific Consideration
State Highway 1 Upgrade (Southern Section)	3	• No specific sites identified
Matakana Road Upgrade	4	• No specific sites identified
Sandspit Road Upgrade	5	• Quarry Site
Western Link South	6	• No specific sites identified
Sandspit Link	7	• Quarry Site
Wider Western Link - (Northern Section)	8	• No specific sites identified

5.2.2 Temporary Traffic Management Effects Assessment

It is considered that temporary effects from the construction activities on network can be adequately managed through the implementation of a CTMP during the construction phase of each Project. The purpose of the CTMP is to ensure the construction of each Project is managed in such a way that enables safe and efficient movement of local traffic throughout the construction period and to minimise disruption to road users, particularly the adjacent residential properties and local activities. If required, SSTMP should be developed to manage constraints on access to affected properties.

5.2.3 Recommended measures to avoid, remedy or mitigate construction effects

It is considered that the potential construction traffic effects can be accommodated and managed appropriately via a CTMP. Based on the assessment of transport construction effects, it is recommended:

Condition 18: Construction Traffic Management Plan (CTMP)

a. A CTMP shall be prepared prior to the Start of Construction for a Stage of Work.
b. The objective of the CTMP is to avoid, remedy or mitigate, as far as practicable, adverse construction traffic effects.
c. Particular consideration is to be given to the Hill Street intersection (being the intersection of State Highway 1, Hill Street, Elizabeth Street, Matakana Road, Sandspit Road and Millstream Place);
   To achieve this objective, the CTMP shall include:
   i. methods to manage the effects of temporary traffic management activities on traffic;
   ii. measures to ensure the safety of all transport users;
   iii. the estimated numbers, frequencies, routes and timing of traffic movements, including any specific non-working or non-movement hours to manage vehicular and pedestrian traffic near schools or to manage traffic congestion
   iv. site access routes and access points for heavy vehicles, the size and location of parking areas for plant, construction vehicles and the vehicles of workers and visitors;
   v. identification of detour routes and other methods to ensure the safe management and maintenance of traffic flows, including pedestrians and cyclists, on existing roads;
   vi. methods to maintain vehicle access to property and / or private roads where practicable, or to provide alternative access arrangements when it will not be;
   vii. the management approach to loads on heavy vehicles, including covering loads of fine material, the use of wheel-wash facilities at site exit points and the timely removal of any material deposited or spilled on public roads; and
   viii. methods that will be undertaken to communicate traffic management measures to affected road users (e.g. residents / public / stakeholders / emergency services).
   ix. Auditing, monitoring and reporting requirements relating to traffic management activities shall be undertaken in accordance with the Waka Kotahi Code of Practice for Temporary Traffic Management.

6 NOR 1 – Northern Public Transport Hub + Park and Ride and Western Link - North

This section assesses specific transport matters relating to NOR 1 – Northern Public Transport Hub, Park and Ride and Western Link – North.

6.1 Overview and description of works

The Northern Public Transport Hub is a new long-term public transport interchange located in the northern growth area. The key outcomes sought by the delivery of the hub include:

- a long-term public transport facility to support progressive development in the Northern growth area and expected brownfield development in the existing urban area in Warkworth.
- a facility to address Warkworth town centre constraints including a lack of layover facilities, staff facilities and limited bus stops.
- a key facility that can be utilised to achieve an integrated public transport connectivity without reliance on the implementation of the southern interchange with Ara Tūhono.

6.1.1 Northern Public Transport Hub

The Northern Public Transport Hub is anticipated to include the following facilities:

- Four active bus stops.
- Capacity for at least five services (terminating and through).
- Two layover spaces - includes long distance coaches to Northland.
- Kiss and ride drop off facilities.
- Bus Driver/Staff facilities to be provided for including a break room and a toilet which could be integrated with public toilets potentially.
- Cycle parking integrated/built into buildings/shelters.

In addition to providing for local bus services, walking and cycling trips, it is proposed that the PT Interchange is supplemented with park and ride facility with capacity for up to 250 vehicles.

6.1.2 Western Link - North

The PT hub will connect to the Western Link North. The portion of this corridor that is being assessed as part of this NOR extends from SH1/ Tūhonohono ki Tai through to the proposed bridge crossing, enabling a connection for development in the Warkworth Northern Precinct as provided for in the Warkworth North Precinct (AUP).

It is proposed that the new corridor will allow for an four lane urban arterial cross section with separated cycle lanes and footpaths on the corridor. An indicative cross section is shown below in Figure 6-1.

Figure 6-1: Indicative Design of the Western Link - North

6.2 Existing Public Transport Environment

In comparison to the other proposed NOR, further consideration of the existing public transport environment was considered pertinent to demonstrate the necessity of a new public transport hub. The following section provides an overview of the existing public transport network, with a particular focus on the northern growth area.

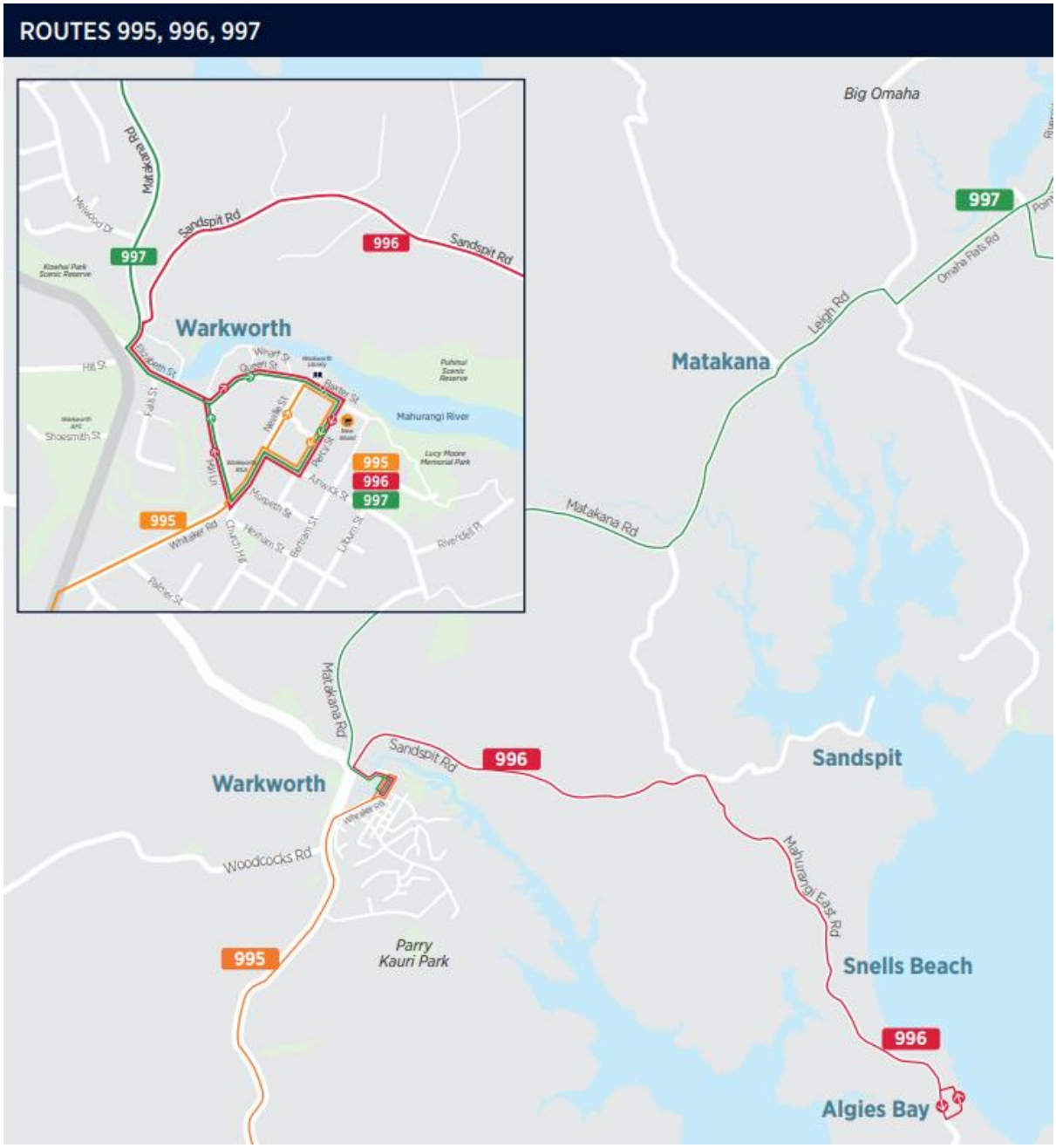
6.2.1 Existing Public Transport Network

The existing public transport network is largely reflective of the predominantly rural or semi-rural environment in Warkworth. The buses are relatively infrequent and in the case of Auckland City bound services – supplemented by private bus services (Mahu Express). Table 6-1 below and Figure 6-2 below summarise the existing public transport network.

Table 6-1: Existing Frequency of Public Transport Services

Service	Frequency
Route 995	Monday to Friday: Every 30mins in the peak, hourly in the day. Saturday and Sunday: Hourly services
Route 996, 997 and 998	Monday to Friday: Every 90minutes Saturday and Sunday: Every two hours
Mahu Express (Private Service)	Monday to Friday – two peak hour services in morning and evening

Figure 6-2: Existing Public Transport Services



6.2.2 Existing Public Transport Facilities

As can be seen in the network map, the core focus of the route services are focused on the Warkworth Town Centre. The current centre experiences significant congestion and has limited facilities for drivers, layover facilities and other ancillary activities such as electric charging.

To address this immediate need, the Rodney Local Board worked with Auckland Transport to provide an interim facility in the north of Warkworth. The interim facilities include 137 parking spaces, two bus stops and a bus layover.

Figure 6-3: Interim Warkworth Community Transport Hub

Through engagement with the Rodney Local Board, it has been confirmed that they have medium to long-term aspirations for land adjacent to the site, as part of wider redevelopments of Council land in the area, including a sports centre and other social infrastructure.

While the site has been designed to support an immediate need, it is bound by SH1 and the Mahurangi River with limited opportunities to expand. The site is not adequate to accommodate the forecasted increase in demand for park and ride, bus stops, bus layovers and charging facilities. It also does not provide sufficient space to provide for driver facilities required to support operational increases in bus services.

6.3 Future Public Transport Environment

The future public transport network in Warkworth is expected to include an increase in the number of routes and also the frequencies of all routes.

In the long term, Figure 6-5 shows the proposed routes based on current land use expectations. This includes the implementation of the southern interchange in the longer term. The network has also been developed to operate effectively without the southern interchange, as shown in Figure 6-4.

In terms of operational frequencies the following changes are expected

- Services 996, 997 and 998 to increase to every 15 minutes, 30 minutes off peak
- A new local service (999) linking Warkworth Town Centre and local centres in North Warkworth and South Warkworth every 15 minutes in the peak, 30 minutes off peak
- 995 service to increase to every 10 minutes in the peak, 30 minutes off peak

Figure 6-4: Long Term Public Transport Network without Ara Tūhono Southern Interchange

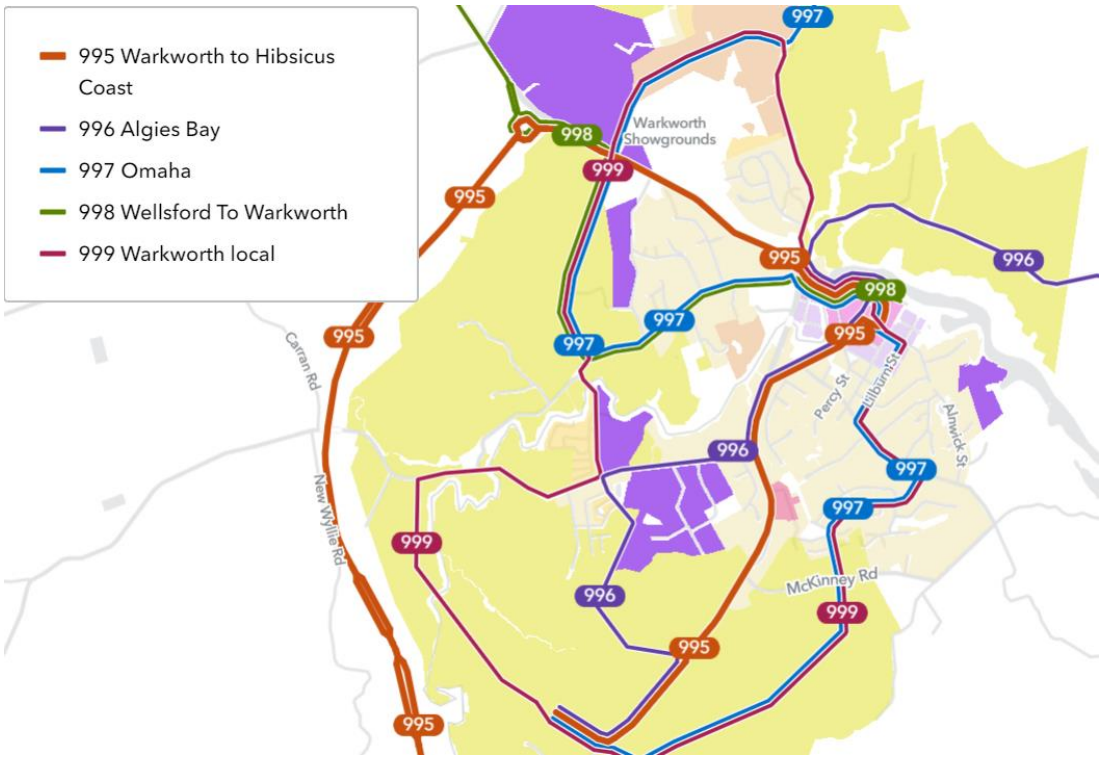
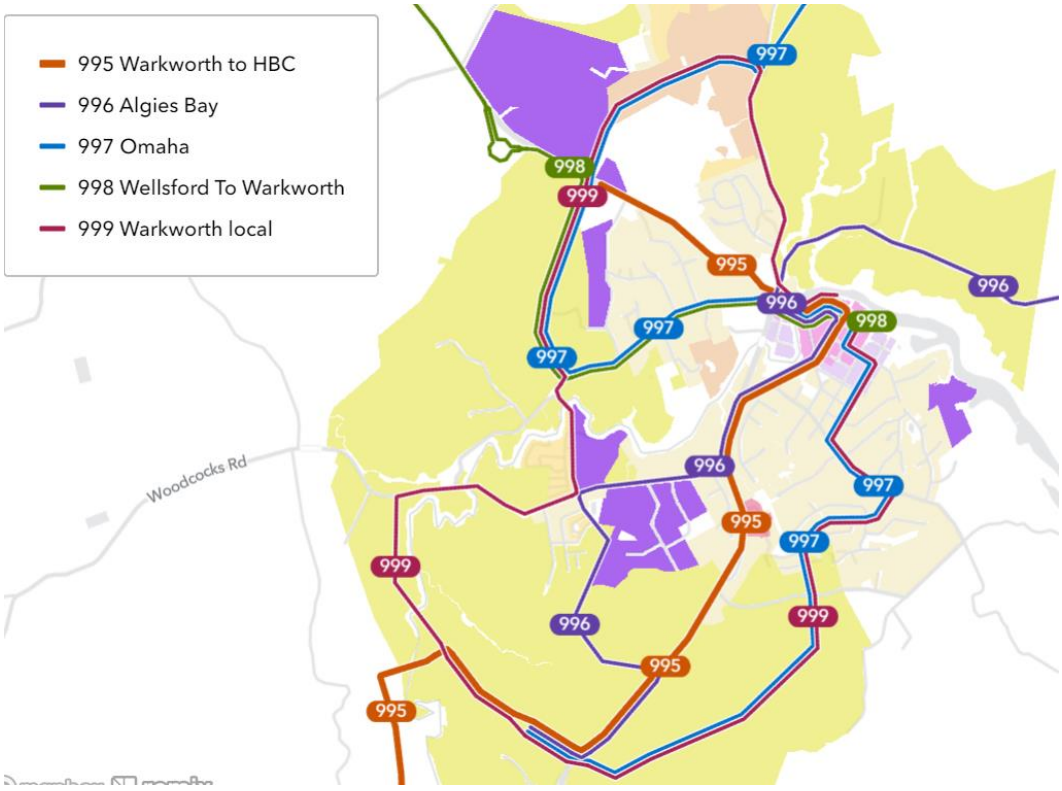


Figure 6-5: Long Term Public Transport Network with Ara Tūhono Southern Interchange



With the implementation of the southern interchange, the network will remain largely as existing with the exception of the 995 route. This will be reorientated to take advantage of access to the strategic network from the Southern Interchange. Interregional services are expected to continue utilising the northern Bus Hub/ Interchange and the motorway northern interchange with Ara Tūhono. The park and ride will remain with the northern station, consistent with the objectives of capturing hinterland trips, and locations on the edge of urban areas.

There will be a slight increase in bus journey times for those that travel by private vehicle to the Park and Ride. This is as a result of the rerouting of the 995. Overall, this is considered to be minor in the context of wider journey lengths to Auckland by bus, and the wider benefits to local residents that will catch the 995 without utilising park and ride facilities or needing to transfer from local services.

6.4 Assessment of Operational Transport Effects

6.4.1 Public Transport

For future public transport services there are three frequent bus services which will use the Western Link – North. These include:

- The 999, 889 and 997 services are forecast to operate every 15 minutes in the peak commute hours, and every 30 minutes outside of the peak.

The cross-section will provide adequate spacing to facilitate public transport and associated bus stops. The exact location of bus stops will be identified as part of detailed design for the project. Once greater certainty is available on the location of key land use activities, more certainty on high demand locations for bus stops can be determined, i.e. around centres and schools for example.

In order to maintain reliability and efficient bus movements, a four-lane corridor has been allowed for on the Western Link North.. This corridor with some 12,000 vehicle per day and 12 buses an hour will benefit from dedicated bus lanes in peak periods, enabling fast and reliable access to the PT Hub.

6.4.1.1 Northern Bus Hub / Interchange

An island hub arrangement is required to facilitate at least four services (terminating and through) with no reserving movements within the hub. This arrangement is similar to other northern busway hubs, consistent with AT's Transport Design Manual and has been developed in consultation with AT subject matter experts.

The Northern Bus Hub/Interchange is anticipated to include the following facilities:

- Four active bus stops
- Capacity for at least five services (terminating and through) Note: no reverse movements within the transport hub, so turning facilities to be considered in overall shape and dimensions
- Two layover spaces - includes long distance coaches to Northland
- Kiss and ride drop off facilities
- Bus Driver/Staff facilities to be provided for including a break room and a toilet which could be integrated with public toilets potentially.
- Cycle parking integrated/built into buildings/shelters

To accommodate the above facilities the spatial area required is between 2,000 – 2,400m². These areas are indicative and further design is recommended prior to implementation to refine the functionality of

the hub within the network. This may consider the immediate demands on the network, whilst also considering longer aspirations.

6.4.1.2 Park and Ride

Transport modelling indicates that once fully developed, private vehicle demand in Warkworth for a northern transport interchange and Park and Ride facility in the morning peak is approximately 300 trips. This includes a proportion of drop offs and kiss and rides, with approximately 70 – 80% of car-based demand expected to be seeking to utilise the park and ride.

Accordingly, a provision of a park and ride capacity of some 220 – 250 spaces is considered appropriate. This represents a 30% capture of people traveling south to Auckland from the hinterland around Warkworth. It should be noted that the hub will also accommodate a kiss and ride zone, cycle parking, and is anticipated to serve walk-up catchment. These attributes are expected to encourage more users through the hub as opposed to the car park facilities alone.

It is also noted that it is important to strike a careful balance between park and ride provision, and provision of higher frequency local services. Door to door travel by bus should be supported, and in some cases a high provision of Park and Ride spaces can be detrimental to local services, and work against encouraging travellers to use local services and transfer at the interchange. As such, an overall provision of 220 – 250 spaces is considered to be appropriate.

The current facility located on State Highway 1 provides for some 135 park and ride spaces and will be insufficient to support increasing demand resulting from projected urban growth.

6.4.1.3 Overall Public Transport Effects

The project's operational effects on public transport are:

- Improved accessibility for future frequent public transport network along the Western Link. This will facilitate access to the proposed medium-density residential growth and local town centre located along the corridor.
- Improved integration with the future public transport network and improved north-south connectivity, as well as improved access to employment and social amenities.
- Increased attractiveness and uptake of public transport trips which will reduce reliance on vehicle trips, resulting in positive environmental and health benefits.

In addition, there are several operational effects related to the provision of the Northern PT interchange and Park and Ride. These include:

- Improved access to public transport for communities to the north of Warkworth, maximising mode shift from the hinterland
- Improved opportunity to intercept vehicles from wider area, resulting in reduced travel through the urban of Warkworth

6.4.2 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The

Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 11,600 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 1,160 vehicles. A two-lane corridor can efficiently accommodate 11,600 vehicles and therefore the proposed corridor design meets the forecasted needs, with the additional lane provision to accommodate greater bus priority.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 6-2.

Table 6-2: Western Link - North Intersection Performance

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Western Link - North /SH1/ Matakana Link Road	Morning Peak	C	0.522	71.2
	Evening Peak	C	0.545	71.1

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

6.4.3 Property Access

The Western Link - North is expected to be a limited access corridor in the future. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

The collector network has been indicatively identified by the Warkworth Structure Plan; however it is expected that these will be subject to change as developers progress these connections through the plan change process. These will be assessed by standard planning and approval processes through Council.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. There are no specific properties that have been included within the designation for this purpose and all existing driveways are expected to be able to be reinstated.

In addition, an opportunity exists to improve access to a cemetery site located to the west of the PT Hub. Access to this cemetery is currently via State Highway 1 and turning movements are compromised by high traffic volumes and multiple lanes.

6.4.4 Freight

Given the adjacent medium-density residential growth and local town centre, the Western Link - North is not expected to be a key strategic freight route in the future. However, as the corridor connects to heavy industrial land use further south, a small proportion of freight may travel through the corridor to access Ara Tūhono in North Warkworth. It is expected that these freight numbers won't warrant any specific freight provisions in the future.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

6.4.5 Wider Network Effects

The Western Link - North provides a connection for all modes to access the planned growth within North Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. This will allow improved accessibility to the Northern PT Hub for those travelling by active modes. This will encourage the use of active mode trips as last mile trips from the adjacent residential growth within North Warkworth. Therefore, the development of this new connection will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the location of the corridor has a positive network effect by facilitating access to the residential growth and local town centre adjacent to Northern PT Interchange. For PT, the development of the Western Link - North , includes bus priority lanes which is in response to the higher-frequency bus services expected along the corridor. This will provide sufficient priority for buses travelling along the corridor and improve access to wider Warkworth from the Northern growth area.

6.5 Project Interdependencies

The Northern Public Transport Hub, Park and Ride and Western Link - North has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The project interfaces with three connections as part of the planned growth within North Warkworth, this includes Tūhonohono ki Tai, existing SH1 and the Western Link. The full benefits of the project, particularly for PT within North Warkworth will not be realised until all of these projects are completed. This is due the key role that the project plays by supporting local services travelling within North Warkworth.

In addition to the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

6.6 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved public transport outcomes, and active mode improvements, improving safety for those that walk and cycle. There are no identified adverse operational effects. There is considered to be a significant opportunity improve access to the cemetery adjacent to the project.

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

7 NOR 2 – Woodcocks Road Upgrade (Western Section)

This section assesses specific transport matters relating to NOR 2 – Woodcocks Road (Western Section).

7.1 Overview and description of works

Woodcocks Road is an existing arterial corridor on the Warkworth network. The corridor extends from SH1 in the east to Wylie Road in the west. In addition, the corridor connects to several key north-south links in south-west Warkworth such as the Wider Western Link – (Northern Section).

The Woodcocks Road upgrade extends along the rural portion of the corridor between Mansel Drive and Wylie Road. It is proposed that the existing rural corridor be upgraded to accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths the corridor. It includes upgrades to the intersection of Wylie Road, which will also form the connection point for the Wider Western Link.

Figure 7-1: Woodcocks Road Upgrade Indicative Design

Key features of the proposed new corridor include the following:

- Widening of the rural portion of Woodcocks Road to a 24m two-lane cross section, including separated cycle lanes and footpaths on both sides of the corridor.
- Localised widening around the existing intersections to accommodate new intersection forms.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

7.2 Assessment of Operational Transport Effects

7.2.1 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 6,200 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 620 vehicles. A two-lane corridor can efficiently accommodate 6,200 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 7-1.

Table 7-1: Woodcocks Road Upgrade Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Woodcocks Road/Wider Western Link – (Northern Section) – Single-lane roundabout	Morning Peak	A	0.202	9.8
	Evening Peak	A	0.276	12.5

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

7.2.2 Property Access

As a future arterial corridor, Woodcocks Road is expected to be a limited access corridor. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. There are no specific properties that have been included within the designation for this purpose and all existing driveways are expected to be able to be reinstated.

7.2.3 Freight

The urban section of Woodcocks Road (between SH1 and Mansell Drive) is currently a Level 1B freight route within Auckland Transport's Strategic Freight Network Map[14]. It is noted that with the continued industrial land use along the corridor, Woodcocks Road is expected to be a strategic freight route in the future. In addition the location of the Southern Interchange to the south of Woodcocks Road, will further encourage strategic freight trips to occur through the corridor to adjacent industrial areas. It is noted that there is an existing school on Woodcocks Road (Mahurangi College) and a new proposed school to the west adjacent to the proposed NoR. In this case, it is considered that the implementation of walking and cycling as part of the NOR are important to minimise potential conflicts as a result of the combination of land use on this corridor.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

7.2.4 Wider Network Effects

The Woodcocks Road (western section) upgrade provides a connection for all modes to access the planned growth within South-West Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will connect to adjacent north-south active mode facilities on the Wider Western Link – (Northern Section) and Western Link. In combination, these connections will provide a complete, legible active mode network within South-West Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities. Therefore, the upgrade to Woodcocks Road will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the location of the corridor has a positive network effect by facilitating access to land use adjacent to the corridor as well as the strategic motorway network (via the Wider Western Link).

7.3 Project Interdependencies

The upgrade to Woodcocks Road (western section) has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network. The Urban Design and Landscape Plan condition requires that these matters be confirmed prior to implementation.

The two key projects within the Warkworth Package that integrate with this project include the Wider Western Link and Western Link (North and South). These two new corridors will connect with Woodcocks Road, providing alternative routes to Woodcocks Road. They are however unlikely to be

[14] https://mahere.at.govt.nz/portal/apps/webappviewer/index.html?id=53d7df8746c049a1a4f7872312190001

implemented prior to land use release in the south and are not required to be in place prior to the Woodcocks Road upgrade. The upgrade of Woodcocks Road can occur independent of these projects, and the walking and cycling benefits in particular are considered to be highly beneficial once land adjacent to Woodcocks Road is released.

These two projects interface with the Woodcocks Road project at key intersections and in order to support the implementation of these projects within the context of timing uncertainties, the designations are proposed to overlap. In addition to the overlapping designation at the intersections, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

Outside of the Warkworth Package, the proposed southern interchange with Ara Tūhono also influences transport movements in Warkworth. The table below provides a summary of the transport volumes expected on Woodcocks Road with and without the interchange in place. As can be seen, the provision on the interchange result in an increase of 700 vehicles per day on Woodcocks Road.

Traffic Volumes on Woodcocks Road with Southern Interchange	**Traffic Volumes on Woodcocks Road without Southern Interchange**
8,400 vehicles per day	7,800 vehicles per day

As noted above, the generally accepted capacity of a two-lane corridor is 1,500 to 2,400 vehicles per peak hour. While the southern interchange is predicted to increase the volumes of vehicles on the corridor, it remains within the overall capacity of the corridor. There is expected to be a corresponding increase in freight movements as a result of the interchange, however this is also expected to be within the operating capacity of the corridor.

7.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

At the time of implementation, the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network. For Woodcocks Road this will include consideration of the existing land use activities which will likely include light industrial activities, residential and educational activities. The Urban Design and Landscape Plan condition requires that these matters be confirmed prior to implementation.

8 NOR 3 – State Highway 1 (Southern Section)

This section assesses specific transport matters relating to NOR 3 – State Highway 1 (Southern Section).

8.1 Overview and description of works

State Highway 1 is an existing strategic motorway connection on the Warkworth network. The State Highway 1 (Southern Section) upgrade is for the portion of the corridor between Fairwater Road and the edge of the Future Urban Zone. It is proposed that the existing corridor be upgraded to accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths on the corridor. It includes upgrades to the intersections at Fairwater Road, McKinney Road and a new intersection with the Wider Western Link.

The indicative proposed design includes two general vehicle lanes and new facilities for walking and cycling as shown in Figure 8-1

Figure 8-1: SH1 (Southern Section) Upgrade Indicative Design

Key features of the proposed new corridor include the following:

- Widening of the existing road corridor to a 24m two-lane cross section, including separated cycle lanes and footpaths on both sides of the corridor.
- Localised widening around the existing intersections to accommodate new intersection forms.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

8.2 Assessment of Operational Transport Effects

8.2.1 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 15,400 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 1,540 vehicles. A two-lane corridor can efficiently accommodate 15,400 vehicles and therefore the proposed corridor design meets the forecasted needs.

It is noted that existing traffic volumes on State Highway 1 south of McKinney Road are currently in the vicinity of 18,700 vehicles per day, and in 2019 averaged 24,500. Given that the projected volumes are lower than existing, even with the introduction of intersections at McKinney Road and the Wider Western Link, a two lane corridor is considered to provide sufficient vehicle capacity.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 8-1.

Table 8-1: SH1 (Southern Section) Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
SH1/ Fairwater Road – signalised intersection	Morning Peak	B	0.275	46.7
	Evening Peak	B	0.228	39.5
Western Link – South/ SH1/ Mckinney Road – signalised intersection	Morning Peak	C	0.738	84.5
	Evening Peak	C	0.829	107.3
SH1/ Wider Western Link – (Northern Section) – single lane roundabout	Morning Peak	A	0.413	26.8
	Evening Peak	A	0.540	34.1

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

8.2.2 Property Access

SH1 (southern section) is expected to be a limited access corridor in the future. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

The collector network has been indicatively identified by the Warkworth Structure Plan; however it is expected that these will be subject to change as developers progress these connections through the plan change process. These will be assessed by standard planning and approval processes through Council.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways.

No specific access effects have been identified for this NOR.

8.2.3 Freight

This portion of SH1 is currently a Level 1A freight route within Auckland Transport's Strategic Freight Network Map[15]. This is due to the lack of alternative strategic motorway connections between Warkworth and the rest of Auckland. However, with the development of Ara Tūhono (Puhoi - Warkworth) motorway, SH1 will likely play a supplementary role in the future as the majority of freight gets re-routed to the new motorway.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

8.2.4 Wider Network Effects

The SH1 (southern section) upgrade provides a connection for all modes to access the planned residential growth within South Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will connect the residential growth adjacent to the corridor with the proposed town centre and Southern PT Interchange (not subject to NOR) adjacent to the Wider Western Link.

In addition, the corridor will connect with adjacent east-west active mode facilities along the Wider Western Link – (Northern Section) and Western Link - South. In combination, these connections will provide a complete, legible active mode network within South Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities Therefore, the upgrade to the southern section of SH1 will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the upgrade of the corridor has a positive network effect by facilitating access to South Warkworth.

[15] https://mahere.at.govt.nz/portal/apps/webappviewer/index.html?id=53d7df8746c049a1a4f7872312190001

8.3 Project Interdependencies

The upgrade to SH1 (southern section) has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The SH1 (southern section) upgrade connects with two new connections as part of the planned growth within South Warkworth, this includes the Wider Western Link and Western Link – South. While the upgrade to SH1 could be implemented prior to the delivery of these new connections with no adverse effect, the full network benefits particularly for walking and cycling within South Warkworth will not be realised until all of these projects are completed. To manage these effect overlapping designations are proposed for these key intersections.

The State Highway 1 and Western Link intersection are inherently linked due to the limited site distances at the intersection. This intersection location provides the best connectivity for all modes and supports an integrated network with direct links. However, sight lines to the north of the intersection are limited. As such, the State Highway 1 projects includes a lowering of the corridor in this location to enable clear visibility. To address this, the designation for the Western Link South and also includes a portion of State Highway network to ensure that these works are carried out as part of the connection.

In addition to the overlapping designation at the intersections, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

The development of the new Ara Tūhono (Puhoi - Warkworth) motorway is key to the future operation and function of the existing SH1. The new motorway is expected to carry a significant proportion of vehicle and freight traffic that would otherwise travel along SH1. Without the new motorway, traffic along the corridor would continue to significantly increase. This could have adverse effects on the overall congestion along the corridor and increase the risk for active mode users. However, Ara Tūhono is expected to be completed prior to the SH1 upgrade, therefore there is little risk of these operational effects occurring in the future.

Outside of the Warkworth Package, the proposed southern interchange with Ara Tūhono also influences transport movements in Warkworth. The table below provides a summary of the transport volumes expected on State Highway 1 with and without the interchange in place. This count is outside of the Future Urban Area so to identify demand changes from people travelling from outside of Warkworth. As can be seen, the provision on the interchange result in a decrease of some 4,000 vehicles on State Highway 1, south of the growth area.

Traffic Volumes on State Highway 1 (location of count south of the Future Urban Area) with Southern Interchange 2048+	Traffic Volumes on State Highway 1 (location of count outside of the Future Urban Area) without Southern Interchange 2048+
6,200 vehicles per day	10,100 vehicles per day

The southern interchange is predicted to decrease the volumes of vehicles on the corridor. There is also expected to be a corresponding decrease in freight movements as a result of the interchange, which will support the urbanisation of the corridor.

8.3.1 Interaction with Proposed Plan Change

It is understood that a Private Plan Change has be lodged with Auckland Council for an area within the southern growth area. A proposed connection location has been provided on State Highway 1 to provide for the future Wider Western Link. This currently allows for sufficient space for either a roundabout or a signalised intersection, with the use of roundabout forming the initial design footprint. It is also understood that location is in general accordance with the Private Plan Change location, with some flexibility in exact location.

Confirmation of the intersection form will be part of the Urban Design and Landscape Management Plan as identified in Condition 9.

8.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

9 NOR 4 – Matakana Road Upgrade

This section assesses specific transport matters relating to NOR 4 – Matakana Road.

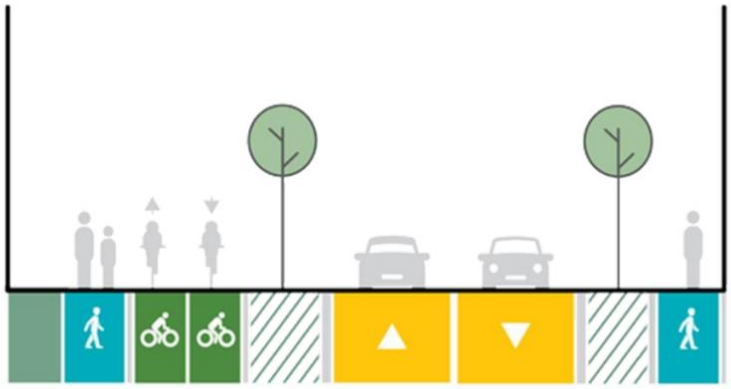
9.1 Overview and description of works

Matakana Road is an existing arterial corridor on the Warkworth network. The corridor extends from the Hill Street intersection in the south to the rural town of Matakana further north. In addition, the corridor is a key connection to rural settlements such as Omaha and Leigh. The Matakana Road upgrade is for the portion of the corridor between the Hill Street intersection and the edge of the FUZ. It is proposed that the existing rural corridor be upgraded to accommodate an indicative two lane urban arterial cross section with dedicated cycle lanes and footpaths. The portion of the corridor between Hill Street and Melwood Drive is proposed to have a bidirectional facility for cyclists, rather than separate cycle lanes on the corridor.

The project will integrate with the proposed intersection at Sandspit Road in the south and will tie into the intersection with Te Honohono ki tai in the north. It should be noted that the intersection upgrade with Sandspit Road forms part of the Hill Street intersection improvements which is a separate project led by Auckland Transport.

Figure 9-1: Matakana Road Upgrade Indicative Design

Figure 9-2: Matakana Road Upgrade Indicative Design (Southern Section)



Key features of the proposed new corridor include the following:

- Widening of the existing road corridor to a 18m-24m two-lane cross section, including separated cycle lanes and footpaths.
- Localised widening around the existing intersections to accommodate new intersection forms.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

9.2 Assessment of Operational Transport Effects

9.2.1 Walking and Cycling

As mentioned in the above description, the indicative design for Matakana Road varies along the corridor. In particular it is noted that walking and cycling facilities change from separated facilities on both sides of the road in the northern section to a two way cycling facility and footpath in the southern section.

These have been indicatively shown due to

- Enabling integration with the surrounding road network including facilities proposed as part of the Hill Street intersection upgrades and
- A significantly constrained environment limiting the corridor width available for upgrades without significant earthworks.

Although the facility type changes along the corridor, the proposed facilities meet current Transport Design Manual standards and as such the net effect for walking and cycling is positive, with a significant improvement over the existing facilities.

9.2.2 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 9,700 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 970 vehicles. A two-lane corridor can efficiently accommodate 9,700 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 9-1.

Table 9-1: Matakana Road Upgrade Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Matakana Road/ Matakana Link Road/ Sandspit Link – single lane roundabout	Morning Peak	A	0.343	17.7
	Evening Peak	A	0.474	29.8

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

9.2.3 Property Access

As a future arterial corridor, Matakana Road is expected to be a limited access corridor. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

The collector network has been indicatively identified by the Warkworth Structure Plan; however it is expected that these will be subject to change as developers progress these connections through the plan change process. These will be assessed by standard planning and approval processes through Council.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. When considering access to existing properties, no specific access effects have been identified.

9.2.4 Freight

Given the adjacent urban residential land use, Matakana Road is not expected to be a key strategic freight route in the future. However, as the corridor is the main connection to rural settlements (i.e. Leigh and Omaha) further north, a small proportion of freight will travel through the corridor. It is expected that these freight numbers won't warrant any specific freight provisions in the future.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

9.2.5 Wider Network Effects

The Matakana Road upgrade provides a connection for all modes to access the planned growth within North Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will connect to adjacent east-west active mode facilities along Matakana Link and Sandspit Link. In combination, these connections will provide a complete, legible active mode network within North Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities Therefore, the upgrade to Matakana Road will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the location of the corridor has a positive network effect by facilitating access to land use adjacent to the corridor as well as rural settlements further north.

9.3 Project Interdependencies

The upgrade to Matakana Road has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The key projects that integrate with this project include Te Honohono ki Tai and Sandspit Link and Sandspit Road. These projects interface with the Matakana Road project at key intersections and in order to support the implementation of these projects within the context of timing uncertainties, the designations are proposed to overlap.

In addition to this, this project interfaces with the proposed upgrades to the Matakana Road and Sandspit Road intersection. The proposed walking and cycling facilities on Matakana Road are proposed to tie with the current proposed provision of facilities at this intersection. It is noted that the Hill Street Intersection upgrades are still under review with detailed design currently underway and under consultation. The proposed designation is considered flexible enough to respond to any changes and provide for a connected walking and cycling facility.

In addition to the overlapping designation at the intersections and the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

9.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

10 NOR 5 – Sandspit Road Upgrade

This section assesses specific transport matters relating to NOR 5 – Sandspit Road.

10.1 Overview and description of works

Sandspit Road is an existing arterial corridor on the Warkworth network. The corridor extends from the Hill Street intersection in the west to the rural town of Sandspit further east. In addition, the corridor is a key connection to rural settlements in Snells Beach and Algies Bay

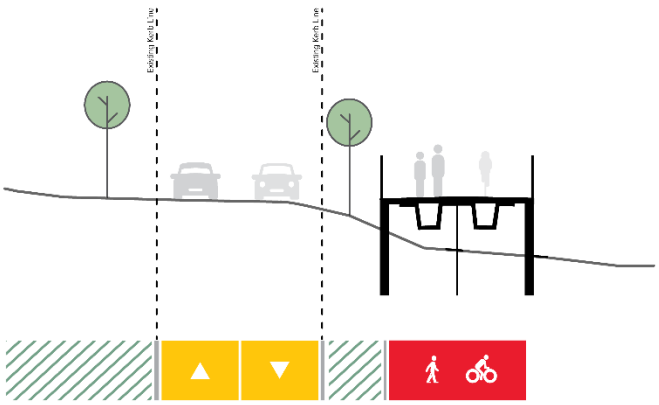
The Sandspit Road upgrade is for the portion of the corridor between the Hill Street intersection and the edge of the FUZ. It is proposed that the existing rural corridor be upgraded to accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths on the corridor (along the eastern portion only).

Along the western portion of Sandspit Road, the cross-section ranges between 18m and 20m, to accommodate active mode users, an offline shared walking and cycling facility has been proposed from the Hill Street intersection to the second bridge along the corridor.

The indicative proposed design also includes two general vehicle lanes and new facilities for walking and cycling as shown in Figure 10-1.

Figure 10-1: Sandspit Road Upgrade Indicative Design – Eastern Portion

Figure 10-2: Sandspit Road Upgrade Indicative Design – Western Portion



Key features of the proposed new corridor include the following:

- Widening of the existing road corridor to a 18m-24m two-lane cross section, including separated cycle lanes and footpaths.
- Provision of a boardwalk facility for walking and cycling on the southern side of the corridor at the eastern extent
- Localised widening around the existing intersections to accommodate new intersection forms.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

10.2 Assessment of Operational Transport Effects

10.2.1 Walking and Cycling

As mentioned in the above description, the indicative design for Sandspit Road varies along the corridor. In particular it is noted that walking and cycling facilities change from separated facilities on both sides of the road in the eastern section to a boardwalk facility on the southern edge of the western section

These have been indicatively shown due to

- Enabling integration with the surrounding road network including facilities proposed as part of the Hill Street intersection upgrades and
- A significantly constrained environment limiting the corridor width available for upgrades without significant earthworks and impact on environmental areas.

Although the facility type changes along the corridor, the proposed facility meets current Transport Design Manual standards and as such the net effect for walking and cycling is positive, with a significant improvement over no facilities as currently provided.

10.2.2 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 12,200 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 1,220 vehicles. A two-lane corridor can efficiently accommodate 12,200 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 10-1.

Table 10-1: Sandspit Road Upgrade Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Sandspit Road/ Sandspit Link – single-lane roundabout	Morning Peak	A	0.407	24.5
	Evening Peak	A	0.374	20.2

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

10.2.3 Property Access

As a future arterial corridor, Sandspit Road is expected to be a limited access corridor. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. When considering access to existing properties, no specific access effects have been identified.

10.2.4 Freight

Given the adjacent residential land use, Sandspit Road is not expected to be a key strategic freight route in the future. However, as the corridor is the main connection to rural settlements (i.e. Snells Beach and Algies Bay) further east, a small proportion of freight will travel through the corridor. In addition, it should be noted that access to the Quarry along Sandspit Road Link will generate some freight movements to and from the area. However, it is expected that these freight numbers do not warrant any specific freight provisions in the future.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

10.2.5 Wider Network Effects

The Sandspit Road upgrade provides a connection for all modes to access the planned growth within North-East Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will

connect to adjacent east-west active mode facilities along Sandspit Road Link. In combination, these connections will provide a complete, legible active mode network within North-East Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities Therefore, the upgrade to Sandspit Road will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the upgrade of the corridor has a positive network effect by facilitating access to the land use adjacent to the corridor as well as rural settlements further east.

10.3 Project Interdependencies

The upgrade to Sandspit Road has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The Sandspit Link is a key project that integrates with the Sandspit Road upgrade. These projects interface at a key intersections and in order to support the implementation of these projects within the context of timing uncertainties, the designations are proposed to overlap.

In regard to traffic volumes, the Sandspit Link corridor is expected to reduce traffic on Sandspit Road, through the provision of an alternative route connecting to Tūhonohono ki Tai. This connection is also expected to reduce volumes on Sandspit Road west of the Sandspit Link intersection and through the Hill Street intersection by 20 to 30%[16]. It is noted that in the event that the provision of the Sandspit Link is not delivered, additional capacity on Sandspit Road would not be required.

In addition to the overlapping designation at the intersections and the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

10.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

[16] Hill Street SSBC, Appendix E, Modelling Technical Report

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

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11 NOR 6 – Western Link South

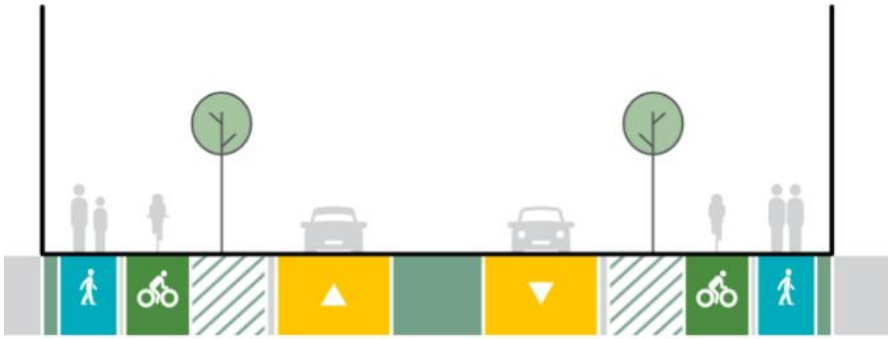
This section assesses specific transport matters relating to NOR 6 – Western Link South.

11.1 Overview and description of works

The Western Link South is a new arterial corridor on the Warkworth transport network. The proposed corridor will connect Woodcocks Road with SH1. It is proposed that the new corridor will accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths the corridor. It includes upgrades to the intersections at McKinney Road. The proposed alignment of the corridor will be through undeveloped greenfields within South Warkworth.

The indicative proposed design includes two general vehicle lanes and new facilities for walking and cycling as shown in Figure 11-1.

Figure 11-1: Western Link South Indicative Design



Key features of the proposed new corridor include the following:

- A new road corridor with a 24m two-lane cross section, including separated cycle lanes and footpaths on both sides of the corridor.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the new road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

11.2 Assessment of Operational Transport Effects

11.2.1 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 9,400 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 940 vehicles. A two-lane corridor can efficiently accommodate 9,400 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 11-1.

Table 11-1: Western Link South Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Western Link – South/ SH1/ Mckinney Road – signalised intersection	Morning Peak	C	0.738	84.5
	Evening Peak	C	0.829	107.3

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

11.2.2 Property Access

Western Link - South is expected to be a limited access corridor in the future. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

The collector network has been indicatively identified by the Warkworth Structure Plan; however it is expected that these will be subject to change as developers progress these connections through the plan change process. These will be assessed by standard planning and approval processes through Council.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. There are no specific properties that have been included within the designation for this purpose and all existing driveways are expected to be able to be reinstated.

11.2.3 Freight

The Western Link South is not expected to be a strategic freight route in the future. In addition, the level of freight expected along the corridor is unlikely to warrant any specific freight provisions in the future. Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

11.2.4 Wider Network Effects

The Western Link South provides a connection for all modes to access the planned residential growth within South Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will allow access to the residential growth within South Warkworth.

In addition, the corridor will connect with adjacent active mode facilities along Woodcocks Road and SH1. In combination, these connections will provide a complete, legible active mode network within South Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities. Therefore, the development of this new connection will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the location of the corridor has a positive network effect by facilitating access to social and employment opportunities within the planned growth in South Warkworth.

11.3 Project Interdependencies

The Western Link - South has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The Western Link - South connects with two existing connections as part of the planned growth within South Warkworth, this includes SH1 and Woodcocks Road. The Western Link – South forms the southern section of the Western Link, which starts further north and provides an alternative north-south spine within the Warkworth network alleviating traffic congestion along SH1.

The State Highway 1 and Western Link intersection are inherently linked due to the limited site distances at the intersection. This intersection location provides the best connectivity for all modes and supports an integrated network with direct links. However, sight lines to the north of the intersection are limited. As such, the State Highway 1 projects includes a lowering of the corridor in this location to enable clear visibility. To address this, the designation for the Western Link South also includes an overlapping designation with the State Highway designation to ensure that these works are carried out as part of the connection.

In addition to the overlapping designation at the intersections and the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

11.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

12 NOR 7 – Sandspit Link

This section assesses specific transport matters relating to NOR 7 – Sandspit Link.

12.1 Overview and description of works

The Sandspit Link is a new arterial corridor on the Warkworth transport network. The proposed corridor will connect Matakana Road and Sandspit Road within North Warkworth. The corridor will facilitate access to the planned growth within this area as well as improve connectivity between Matakana and the Kowhai Coasts. It is proposed that the new corridor will accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths on the corridor. It includes new intersections at Matakana Road and Sandspit Road respectively. The proposed alignment of the corridor will predominately be through undeveloped greenfields within North Warkworth.

The indicative proposed design includes two general vehicle lanes and new facilities for walking and cycling as shown in Figure 12-1.

Figure 12-1: Sandspit Link Indicative Design

Key features of the proposed new corridor include the following:

- A new road corridor with a 24m two-lane cross section, including separated cycle lanes and footpaths on both sides of the corridor.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the new road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

12.2 Assessment of Operational Transport Effects

12.2.1 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 3,600 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 360 vehicles. A two-lane corridor can efficiently accommodate 3,600 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 12-1.

Table 12-1: Sandspit Link Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Sandspit Link/ Matakana Road/ Matakana Link Road – single-lane roundabout	Morning Peak	A	0.343	17.7
	Evening Peak	A	0.474	29.4
Sandspit Link/ Sandspit Road – single-lane roundabout	Morning Peak	A	0.407	24.5
	Evening Peak	A	0.374	20.2

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

12.2.2 Freight

Given the adjacent residential land use, the Sandspit Link is not expected to be a key strategic freight route in the future. However, as the corridor does provide a connection for freight movements from Sandspit, Snells Beach and Algies Bay and as such a small proportion of freight will travel through the corridor. These volumes are expected to be readily accommodated within the proposed corridor.

Over-dimension and overweight routes are expected to be further reviewed by Auckland Transport, Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

12.2.3 Property Access

The Sandspit Link is expected to be a limited access corridor in the future. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to the corridor where practicable.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. When considering access to existing properties, no specific access effects have been identified.

The proposed alignment of the Sandspit Link follows an existing driveway/access that currently services residential properties, a quarry and a recycling plant. Should these properties still require access at time of implementation there are several options to provide access, including construction staging from the northern extent of the corridor or provision of an access route adjacent to the corridor within the designation. The designation is considered sufficiently wider to provide for this. Notwithstanding this, two conditions are expected to manage any potential vehicle access impacts:

- the proposed UDLP condition that requires that the UDLMP shall include landscape and urban design details that cover reinstatement of construction and site compound areas, driveways, accessways and fences and
- the proposed CTMP condition that requires that the CTMP shall include:
  - methods to maintain vehicle access to property and / or private roads where practicable, or to provide alternative access arrangements when it will not be;
  - methods that will be undertaken to communicate traffic management measures to affected road users (e.g. residents / public / stakeholders / emergency services).

12.2.4 Wider Network Effects

The Sandspit Link provides a connection for all modes to access the planned residential growth within North-East Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. In addition, the corridor will connect with adjacent active mode facilities along Matakana Road and Sandspit Road. In combination, these connections will provide a complete, legible active mode network within North-East Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities. Therefore, the development of this new connection will have an overall positive network effect on walking and cycling.

For freight, general traffic and PT, the location of the corridor has a positive network effect by facilitating access to the land use adjacent to the corridor as well as rural settlements within Matakana and Sandpit. However, there are no specific measures within this upgrade that provides additional priority for these modes.

12.3 Project Interdependencies

Sandspit Link has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

While not part of the Warkworth package, the Hill Street improvements will be impacted by the timing of the Sandspit Link. An additional benefit of this new connection is to allow trips to and from the Kowhai Coast settlements to reach Matakana and the strategic network without the need to travel through Hill Street Intersection.

Additional SIDRA modelling completed as part of the Warkworth DBC tested two potential scenarios. The first scenario included the full recommended transport network for Warkworth (including the Sandspit Link), while the second scenario included the full recommended transport network without the Sandspit Link.

It was found that for a Hill Street/SH1 single-lane roundabout option, overall delay and LOS increases in the AM peak without the implementation of the Sandpit Link. For the PM peak there was no change in the overall LOS and a marginal difference in delay between the two scenarios. A summary of the results can be found in Table 12-2 below. The results indicate that without the Sandspit Link, there will be increasingly adverse effects on the performance of the Hill Street/SH1 roundabout during the AM peak in particular. This illustrates the role of Sandspit Link within the wider network.

Table 12-2: Hill Street/SH1 Roundabout Sidra Movement Summaries

Hill Street/SH1 Roundabout 2048+	
With Sandspit Road Link (AM peak)	**Without Sandspit Road Link (AM peak)**
LOS (Level of Service): E Delay: 61s	LOS (Level of Service): F Delay: 95s
With Sandspit Road Link (PM peak)	**Without Sandspit Road Link (PM peak)**
LOS (Level of Service): D Delay: 41s	LOS (Level of Service): D Delay: 39s

*It should be noted that there were negligible differences in performance for the Matakana Road/Sandspit Road roundabout.

In addition to the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of these interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.

- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

12.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects.

In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

It is recommended that access considerations relating to the Quarry and the recycling plant should be specifically considered within the CTMP prior to construction and implementation of the project.

13 NOR 8 – Wider Western Link (Northern Section)

This section assesses specific transport matters relating to NOR 8 – Wider Western Link - (Northern Section).

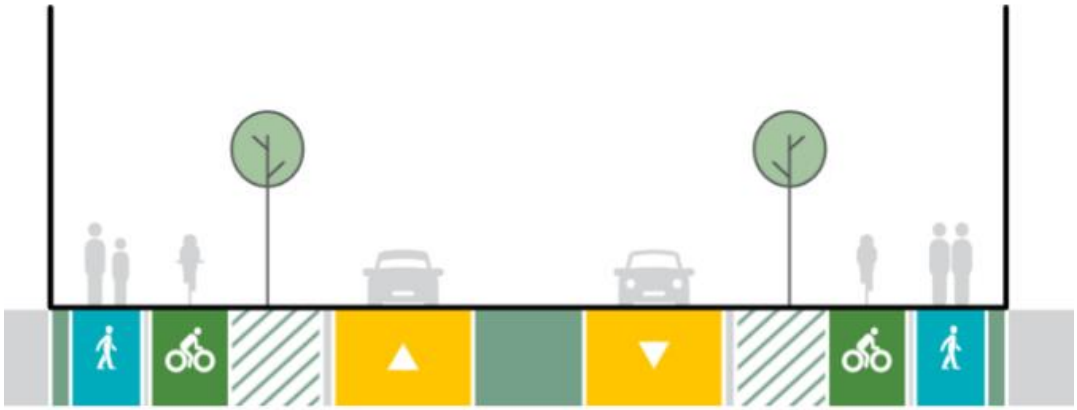
13.1 Overview and description of works

The Wider Western Link - North is a new arterial corridor on the Warkworth transport network. The proposed corridor will connect Woodcocks Road with SH1. It is proposed that the new corridor will accommodate an indicative two lane urban arterial cross section with separated cycle lanes and footpaths on the corridor. It includes new intersections at Woodcocks Road and SH1. The proposed alignment of the corridor will be through undeveloped greenfields within South Warkworth.

The corridor has been indicatively designed to enable future connectivity to the southern interchange with Ara Tūhono.

The indicative proposed design includes two general vehicle lanes and new facilities for walking and cycling as shown in Figure 13-1.

Figure 13-1: Wider Western Link (Northern Portion) Indicative Design



Key features of the proposed new corridor include the following:

- A new road corridor with a 24m two-lane cross section, including separated cycle lanes and footpaths on both sides of the corridor.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the new road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas.

13.2 Assessment of Operational Transport Effects

13.2.1 General Traffic

The theoretical capacity of a single lane with uninterrupted flow conditions is generally within the range of 1,500 to 2,400 vehicles per hour[5], noting these can be lower when considered at a corridor level due to various control features in the corridor (such as intersections, crossings etc). The peak period is generally accepted as 10% of the daily flow (vehicles per day (vpd)) of a corridor. The Transport Design Manual also provides indicative lane capacity for vehicles at 1,800 vehicles per hour. These considerations have been taken into account in the assessment provided below.

As identified above, the 2048 ADT for the corridor is 6,100 vehicles per day. Given that the peak hour volume is typically approximately 10% of the daily total, it is anticipated that the vehicle volume during the peak hours will be in the order of 610 vehicles. A two-lane corridor can efficiently accommodate 6,100 vehicles and therefore the proposed corridor design meets the forecasted needs.

Intersection Performance

The performance of the road network within the project has been assessed using inputs from SATURN to understand intersection performance. SIDRA enables isolated intersection models to be performed to understand the network capacity, predicted LOS and anticipated queue lengths. A summary of these key performance measures is shown below in Table 13-1.

Table 13-1: Wider Western Link – (Northern Section) Intersection Performances

Intersection (Intersection Control)	Peak Period	Overall Level of Service	Degree of Saturation (worst movement)	Maximum Queue Distance (m)
Wider Western Link/ Woodcocks Road– single-lane roundabout	Morning Peak	A	0.202	9.8
	Evening Peak	A	0.276	12.5
Wider Western Link/ Link to the Southern Interchange – single-lane roundabout	Morning Peak	A	0.339	18.0
	Evening Peak	A	0.363	21.9

Overall, the proposed intersections are predicted to perform at a satisfactory level during the peak periods under a 2048+ scenario.

13.2.2 Property Access

The Wider Western Link - North is expected to be a limited access corridor in the future. As the area develops, it is expected that future vehicle access to the network will be facilitated by collector road networks within the urbanised area adjacent to the road. Walking and cycling access will be provided to corridor where practicable.

The collector network has been indicatively identified by the Warkworth Structure Plan; however it is expected that these will be subject to change as developers progress these connections through the

plan change process. These will be assessed by standard planning and approval processes through Council.

In terms of existing properties, the overarching design philosophy for the project has been to maintain driveway access where practicable and minimise impacting land for access purposes other than where necessary to re-instate driveways. There are no specific properties that have been included within the designation for this purpose and all existing driveways are expected to be able to be reinstated.

The proposed alignment of the Wider Western Link connects with Wylie Road, replacing an existing cul de sac (resulting from Ara Tūhono). A small cul de sac will need to be formed to connect the residual Wylie Road corridor with the new proposed arterial. Sufficient space has been provided within the proposed designation to enable this connection.

13.2.3 Freight

It is noted that with the planned industrial land use along the corridor, the northern portion of the Wider Western Link is expected to be a strategic freight route in the future. However, the level of freight expected along the corridor is unlikely to warrant any specific freight provisions in the future and heavy vehicles can be accommodated within the capacity of the corridor.

Over-dimension and overweight routes are expected to be further reviewed by Waka Kotahi and relevant stakeholder groups in alignment with the implementation of individual corridor upgrades and further land use certainty in the future.

13.2.4 Wider Network Effects

The Wider Western Link - North provides a connection for all modes to access the planned growth within South Warkworth. In terms of walking and cycling the project provides improved network options for active modes, through the provision of dedicated facilities. The facilities along this corridor will allow access to the employment opportunities within the industrial land use along the northern portion of the corridor.

In addition, the corridor will connect with adjacent active mode facilities along Woodcocks Road and SH1 further south. In combination, these connections will provide a complete, legible active mode network within South Warkworth. This will allow improved accessibility for those travelling by active modes to local amenities and employment opportunities. Therefore, the development of this new connection will have an overall positive network effect on walking and cycling.

The Wider Western Link integrated with the Wylie Road and reconnects Wylie Road to the wider network. Previously, Wylie Road continued further south, however the provision of Ara Tūhono severed this link, resulting in Wylie Road being reformed as a cul de sac. This proposed connection, will reconnect Wylie Road with the wider network and will continue on to eventually link with State Highway 1. By utilising the existing Wylie Road connection, this reduces the number of intersections on Woodcocks Road, improving safety and efficiency on the Woodcocks Road corridor.

13.3 Project Interdependencies

The Wider Western Link - North has been designed to integrate with several other key projects within the Warkworth transport network. The assessment of operational effects assumes that these projects are in place. The project as proposed therefore can be considered the long-term requirement for the corridor.

It is noted however that in the interim, the rate and sequencing of land use growth, wider growth pressures and timing of individual projects will change and evolve. As such, at the time of implementation the project should demonstrate how it will integrate with the prevailing urban form and surrounding road network.

The Wider Western Link - North connects to Woodcocks Road via Wylie Road in the north and will connect with State Highway 1 in the south in the longer term. The southern section is currently not proposed to be included within the NOR 6 works, however the bridge crossing over the Mahurangi River has been included to enable ready connections to be made by developers in the longer term.

The Wider Western Link is also linked to the Southern Interchange with Ara Tūhono. It is considered that the Wider Western Link can be implemented in such a way that does not preclude the provision of an interchange in the longer term. The Southern Interchange, however, will not be able to be provided until such time that that Wider Western Link is in place, to provide access to the interchange. As such, traffic volumes as utilised in this assessment, with the southern interchange in place, are considered to provide the most conservative assessment of capacity. Without the interchange in place, traffic volumes will be predominately related to immediately adjacent growth, and unrelated to access to the strategic network.

To address the arterial road interdependencies, the intersection of Wider Western Link with Woodcocks Road is proposed to be overlapping. In addition to the overlapping designation at the intersections and the requirements of the Urban Design and Landscape Condition, the following standard implementation measures will be undertaken by Auckland Transport to assist in the management of any interdependencies:

- Roads and Streets Framework and One Network reassessment to confirm modal priority.
- Integration with the Network Operating Plan as per standard procedures by Auckland Transport.
- Detailed Design commensurate with implementation works.
- Road Safety Audits to ensure appropriate and safe tie ins for all modes.

13.4 Recommended Measures to Avoid, Remedy or Mitigate Operational Effects

Overall, the project provides positive transport effects, in particular improved active mode facilities which in turn provide safety improvements for those choose to walk and cycle. There are no identified adverse operational effects. In terms of construction traffic effects, it is considered that there is sufficient network capacity to enable construction traffic, and that any potential construction traffic effects can be accommodated and managed appropriately via a CTMP.

1 Appendix A: Roads and Street Framework Assessment

The development of the corridor design has included the use of AT's Roads and Streets Framework (RASF), which qualitatively assesses the typology (movement and place value) and modal priority. The intent of that framework is to classify the expected movement and place functions from a consistent regional context and identify the likely priority applied to each mode.

The framework itself does not directly dictate a specific corridor design but provides context and guidance regarding the intended function of the corridor, that will be used to inform future development and operation of the corridor. For integrated land use and transport classification purposes, land use context uses Place Value (ranking from P1 'low' to P3 'high' importance) and for transport context uses Movement Value (ranking from M1 'low' to M3 'high' importance).

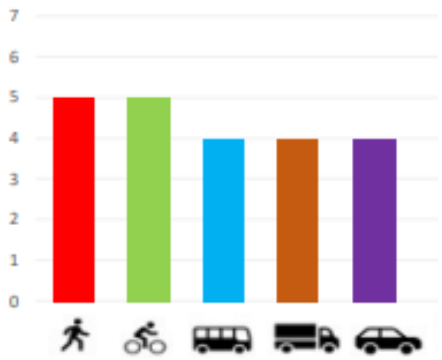
1.1 Western Link - North

The corridor is assessed to have the following RASF typology in the future:

- Place function – P2 (medium place significance) long term
- Movement function – M3 (high strategic network function) long term

The following Figure 13-2 indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-2: Western Link - North Future Modal Priorities



Legend	
	Pedestrians
	Cyclist
	Public Transport
	Freight
	Private Vehicles
	Loading
P	Parking and Access

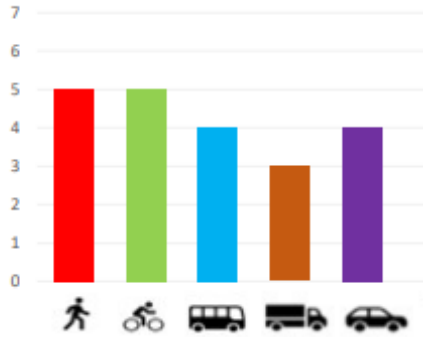
1.2 Woodcocks Road (Western Section)

The corridor is assessed to have the following RASF typology:

- Place function - transitioning from P1 (rural) to P1 (low place significance) long term
- Movement function - transitioning from M1 (low strategic network function) to M2 (medium strategic network function) long term

The following Figure 13-3 indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-3: Woodcocks Road (Western Section) Upgrade Future Modal Priorities



Legend	
	Pedestrians
	Cyclist
	Public Transport
	Freight
	Private Vehicles
	Loading
P	Parking and Access

1.3 State Highway 1 (Southern Section)

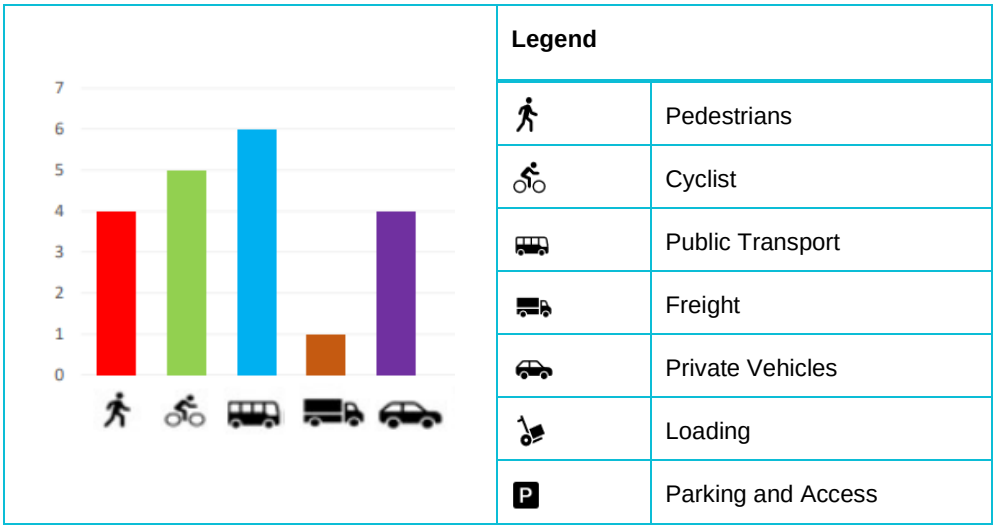
The corridor is assessed to have the following RASF typology:

- Place function - P1 (low place significance) long term
- Movement function - M3 (high strategic network function) long term

There is no change in the place and movement function between the existing environment and expected future environment. In regard to the movement function, SH1 is expected to remain a strategic corridor within the Warkworth transport network in the future. In addition, the place significance of the corridor is expected to remain the same due to the nature of change in land use from the existing rural environment to low-density residential in the future.

The following figure indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-4: SH1 (Southern Section) Upgrade Future Modal Priorities



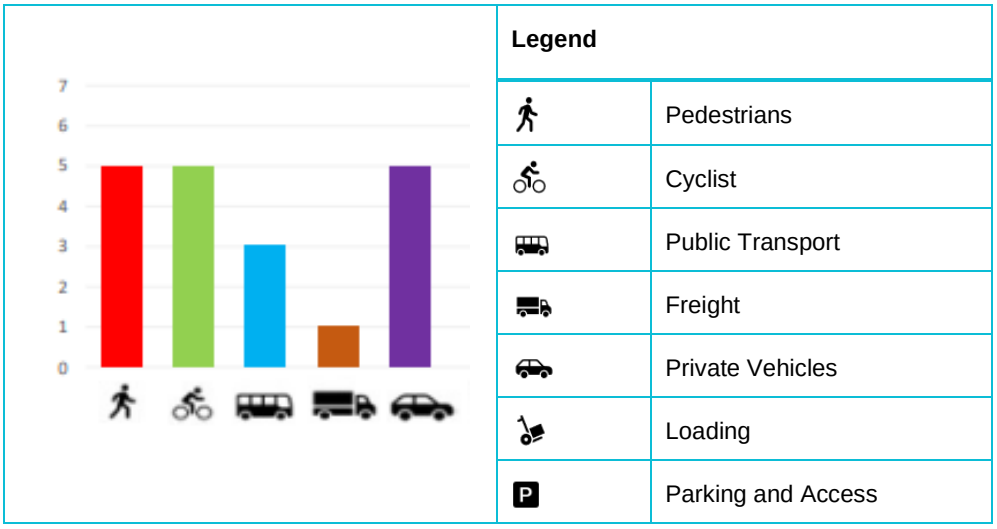
1.4 Matakana Road Upgrade

The corridor is assessed to have the following RASF typology:

- Place function - transitioning from P1 (low place significance) to P2 (medium place significance) long term
- Movement function - transitioning from M2 (medium strategic network function) to M3 (high strategic network function) long term

The following Figure 13-5 indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-5: Matakana Road Upgrade Future Modal Priorities



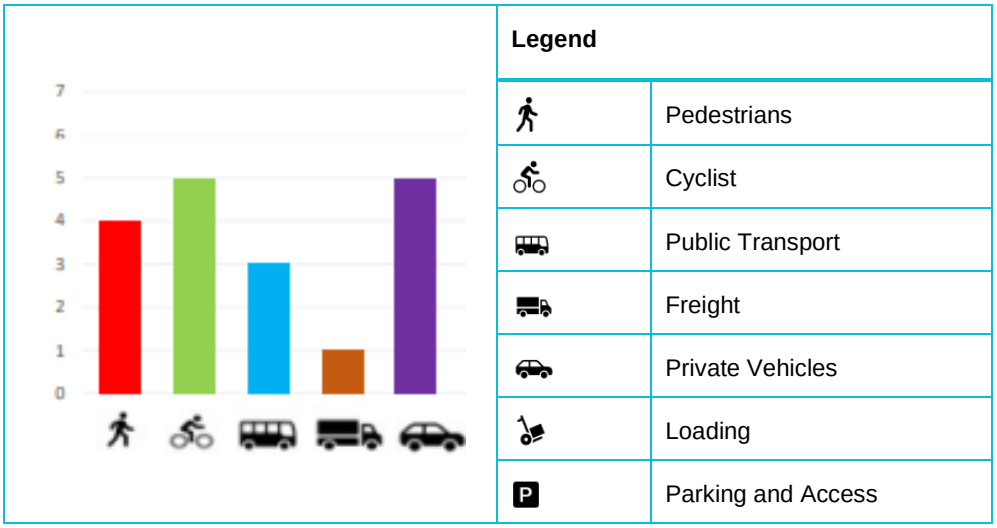
1.5 Sandspit Road Upgrade

The corridor is assessed to have the following RASF typology:

- Place function - transitioning from P1 (low place significance) to P1 (low place significance) long term
- Movement function - transitioning from M2 (medium strategic network function) to M3 (high strategic network function) long term

The following Figure 13-6 indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-6: Sandspit Road Upgrade Future Modal Priorities



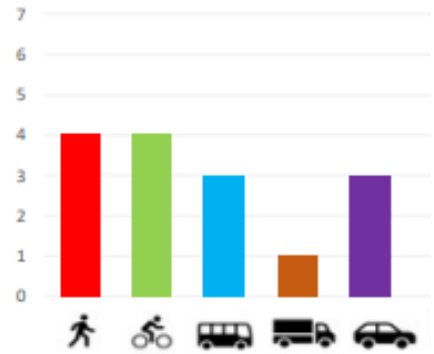
1.6 Western Link South

The corridor is assessed to have the following RASF typology in the future:

- Place function - P1 (low place significance) long term
- Movement function – M2 (medium strategic network function) long term

The following Figure 13-7 indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-7: Western Link South Future Modal Priorities



Legend	
	Pedestrians
	Cyclist
	Public Transport
	Freight
	Private Vehicles
	Loading
P	Parking and Access

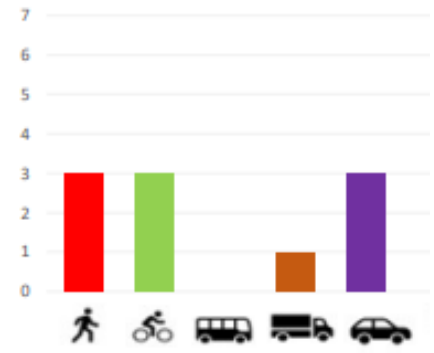
1.7 Sandspit Link

The corridor is assessed to have the following RASF typology in the future:

- Place function – P1 (low place significance) long term
- Movement function – M1 (low strategic network function) long term

The following figure indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-8: Sandspit Link Future Modal Priorities



Legend	
	Pedestrians
	Cyclist
	Public Transport
	Freight
	Private Vehicles
	Loading
P	Parking and Access

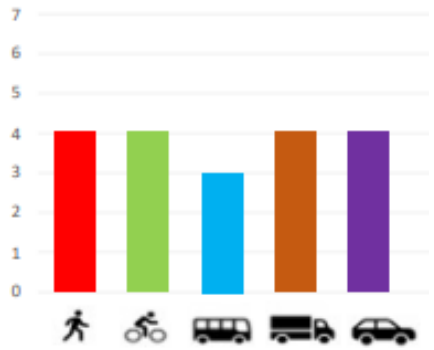
1.8 Wider Western Link - North

The corridor is assessed to have the following RASF typology in the future:

- Place function – P2 (medium place significance) long term
- Movement function – M3 (medium strategic network function) long term

The following figure indicates the likely long-term modal priorities for the corridor. Currently the mode split is heavily weighted to general traffic. As the corridor is upgraded and the area is developed, the mode split is anticipated to shift to active modes and public transport.

Figure 13-9: Wider Western Link – (Northern Section) Future Modal Priorities



Legend	
	Pedestrians
	Cyclist
	Public Transport
	Freight
	Private Vehicles
	Loading
P	Parking and Access

2 Appendix B: Existing Crash Records

The tables below provide a summary of reported crashes on the existing road network subject to the Warkworth Package of NORs. These results are based on a search of the Waka Kotahi Crash Analysis System (CAS) between 2018 and 2022. These results should be considered within the context of several factors including:

- The CAS results are based only on reported crashes, and does not include any crashes that are not reported to the relevant authorities
- Crashes are reflective of the existing road environment, and the relevance within the context of an urban environment with greater traffic volumes, pedestrian and cyclist volumes, and lower speeds may be limited.
- There were a total of 5 DSI's on the existing corridors assessed.
- Out of the existing corridors within Warkworth, Sandspit Road and SH1 had the highest number of crashes. There were a total of 20 and 30 crashes respectively on these corridors.
- For Sandpit Road, the most common crash types were rear-end collisions (7 crashes) and loss of control on corners (4 crashes).
- For SH1, the most common crash types were rear-end collisions (7 crashes), loss of control on corners (5 crashes) and crossing/turning type crashes (4 crashes).
- There were no vulnerable road user DSI's on each of the existing corridors assessed for Warkworth

	Vehicle Crashes per year						Mid-Block (Total over 5 years)				Intersection (Total over 5 years)				Total DSI's
	2018	2019	2020	2021	2022	Total	F	S	M	N	F	S	M	N	
Mansell Drive	1	2	0	0	0	**3**	0	0	0	1	0	0	2	0	**0**
Sandspit Road	7	4	3	3	3	**20**	0	1	3	5	0	0	1	10	**1**

	Vehicle Crashes per year						Mid-Block (Total over 5 years)				Intersection (Total over 5 years)				Total DSI's
	2018	2019	2020	2021	2022	Total	F	S	M	N	F	S	M	N	
Matakana Road	2	1	1	1	0	**5**	0	0	1	3	0	0	0	1	**0**
Woodcocks Road (urban)	2	3	1	0	0	**6**	0	0	1	1	0	0	1	3	**0**
Woodcocks Road (rural)	1	2	3	0	0	**6**	0	1	2	1	0	0	2	0	**1**
SH1 (southern section)	6	10	5	5	4	**30**	2	1	7	5	0	0	7	8	**3**

	Vulnerable Road User Crashes per year						Pedestrian (Total over 5 years)				Cyclist (Total over 5 years)				Motorcyclist (Total over 5 years)				Total DSI's
	2018	2019	2020	2021	2022	Total	F	S	M	N	F	S	M	N	F	S	M	N	
Mansel Drive	0	1	0	0	0	**1**	0	0	1	0	0	0	0	0	0	0	0	0	**0**
Sandspit Road	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	1	0	**0**
Matakana Road	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Woodcocks Road (urban)	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	1	**0**
Woodcocks Road (rural)	0	1	0	0	0	**1**	0	0	1	0	0	0	0	0	0	0	0	0	**0**
SH1 (southern section)	0	1	0	1	0	**2**	0	0	0	0	0	0	0	0	0	0	1	1	**0**

3 Appendix C: Specific Transport Modelling Background Information

The Macro Strategic Model (MSM) is a region-wide model which analyses the forecast land use and informs trip generation, trip distribution and mode choice at regional level. The MSM model responds to the network assumptions, forecasted land use and regional economic policy inputs to predict regional traffic patterns and PT patronages. The outputs from the MSM model are used as:

- Demand inputs for the traffic simulation model SATURN, which analyses them at a mesoscopic level
- PT Patronage inputs for the MPT model, which analyses these at a strategic level
- Active mode inputs for the SAMM model, which analyses these at a mesoscopic level

The MSM is a four-step multi-modal model. This model was originally developed based on extensive data collected in 2006. Using observed data, and a full model validation exercise it was recently updated to reflect 2016 inputs and data. The MSM produces demands for five periods of the day, and separate assignment models exist for the morning (AM) and evening (PM) peak and weekday interpeak (IP) periods.

The model itself comprises of the following key modules:

- Trip generation: This is where the number of person-trips are estimated as a function of the land use data (population, employment, school roll etc.)
- Mode Choice: This is where the choice of recommended travel mode is determined, based on the relative costs of the various modes. The MSM modes for mode choice are car (driver and passenger combined) and passenger transport. Trips by car are converted into vehicle trips later in the model. The model also estimates the number of active mode trips, such as walking and cycling, although these are not fully modelled through to link flows.
- Trip Distribution: This is where the trips produced in each zone (generally by households), are matched to a recommended destination. This distribution is predicted as a function of the relative attractiveness for each destination zone and the travel costs to reach each destination.
- Time of Day: This is where the proportion of daily trip making occurring in each period is calculated. These proportions change in response to changes in travel costs to represent peak spreading.
- Trip Assignment: This is where the resulting travel demand, in the form of origin to destination trip tables, are loaded to the road and public transport networks. For the road assignment, an iterative process is used to firstly identify the lowest-cost route between each origin and destination followed by an estimation of the speeds and delays on each route between origin and destination, followed by an estimation of speeds and delays on each route associated with the predicted traffic flows on the route.

3.1 General Network Assumptions

The following general network assumption have been made in the MSM model:

- All committed developments and respective infrastructure upgrades planned as outlined in the ATAP (Auckland Transport Alignment Project) 2.0 and RLTP (Regional Land Transport Plan) have been coded in the future MSM model

- The access points (MSM zone connectors) for each model option scenarios in the Warkworth Detailed business case areas were reviewed and refined accordingly to reflect the future infrastructure upgrades
- The future local bus services for each model option scenarios, were updated based on inputs from the AT Metro, specifically related to routes, frequencies, bus capacities and bus speeds.

The proposed Warkworth DBC projects and improvements have been identified in order to support growth in Warkworth and unlock the future land use. In addition to these projects, there are several key strategic projects that integrate with this network including:

- Te Honohono ki Tai - Matakana link road
- Ara Tūhono – Pūhoi to Warkworth Motorway.
- Hill Street Roundabout Upgrade

It should be noted that the Warkworth to Wellsford portion of Ara Tūhono has not been included as part of the modelling.

It is the combination of these projects and the proposed Te Tupu Ngātahi projects that will enable the key transport and land use integration outcomes for the Warkworth community.

The inclusion of the key inter-dependent strategic projects in the Do-minimum network is to account for the fact that those projects are being developed by Waka Kotahi, so are not included as part of the Te Tupu Ngātahi improvements package.

The following changes between the Do-minimum (Do-min) and recommended transport network (Recommended Option) are noted below:

- **Road Network**: The Do-minimum network includes the existing arterial and local road connections within Warkworth. The recommended network includes the existing network and new links along the Wider Western Link, Western Link – South, Western Link – North and Sandspit Road Link.
- **PT Services**: The PT network within the Do-minimum consists of three routes that travel along SH1, Matakana Road and Sandspit Road respectively. The frequency of these routes ranges between 30 minutes and 60 minutes during the weekday. In comparison, there are several high-frequency routes (10 minutes to 15 minutes during the weekday) within the recommended transport network. These routes cover most of the urban area within Warkworth and travel along both the existing and new corridors within the network.
- **Active Mode Connections**: There is a full cycle network along both existing and new connections within the Warkworth recommended transport network. The connections present in the Do-minimum network are existing/planned facilities along SH1 between Hudson Road and Woodcocks Road.

3.2 MSM Outputs

There are a number of outputs from the transport modelling, including:

- Demand patterns (Origin-Destination travel) and facility usage (flows)
- Network performance
- Travel times and costs (real and perceived) for economic analysis
- Delays, queues and Level of Service (LoS) for design and assessment

- Aggregate travel statistics on travel such as Vehicle Kilometres Travelled (VKT), Passenger Kilometres Travelled (PKT) and total travel costs
- Flow and performance for environmental analysis
- Inputs to vehicle emissions models
- Inputs to noise analysis

3.3 SATURN

SATURN is a mesoscopic traffic simulation and assignment model used to undertake a variety of area wide strategic assessments through to more detailed local area assessments. It can be used as a conventional model for the analysis of traffic-management schemes over localised networks as well as for major investment improvements at a regional level. The SATURN model ensures factual representation of vehicle flow patterns and congestion on midblock sections and intersections in the form of 'arrival' flows rather than 'demand' flows. Additionally, it is used as a high-level junction simulation model that evaluates the traffic flow behaviour on junctions. It represents 'congested assignment' of multiple user classes modelled separately, including bus priority and high occupancy vehicle lanes.

3.3.1 SATURN Outputs

There are a number of outputs from the SATURN model, including:

- Vehicular flow pattern -Actual flow, Demand flow, Queued flow
- Network performance- Link and Node delays, Queue Statistics, V/C Ratios
- Mid-block capacities and speeds
- Aggregate travel statistics on travel such as Total Travel Time(hrs), Distance Travelled (kms)

3.4 SIDRA

Signalised (and unsignalised) Intersection Design and Research Aid (SIDRA) is a micro-analytical tool used for evaluating intersection performance. It has a comprehensive, lane-based network modelling approach applicable to all types on intersections-signal, priority or sign control and roundabouts. SIDRA allows the modelling of various movement classes (Light vehicle, Heavy vehicle, Buses, Bicycle, Large Trucks, Light Rail/ Trams) with distinctive vehicle features to be assigned to designated lanes, segments and signal phases.

The Te Tupu Ngātahi SIDRA model is used to analyse the form and function of proposed intersections along strategic corridors. Based on the demand flow outputs from the SATURN Model, the intersection turning flows are determined.

The performance measures of the intersection in terms of capacity, delay, Level of Service (LOS), queue length on approach lanes and optimum vehicle-pedestrian signal phasing is calculated.

It is noted that the SIDRA model is reliant on outputs from the SATURN model, with traffic distribution based on the network provided in SATURN. A finer grain network that includes all collectors and local roads is not provided in SATURN, and as such it can considered that intersection modelling in SIDRA results in a conservative assumption of performance.

3.5 SIDRA Results for 2048+ Intersection Modelling

Western Link - North /SH1/ Matakana Link Road

MOVEMENT SUMMARY

Site: 101 [Matakana Link Road - Western Link Road_AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Western Link Road - North												
1	L2	167	18.2	0.165	10.2	LOS B	2.4	19.0	0.41	0.66	0.41	50.4
2	T1	213	6.4	0.375	42.4	LOS D	4.8	35.5	0.94	0.75	0.94	35.5
3	R2	82	21.8	0.230	40.9	LOS D	3.3	27.8	0.86	0.76	0.86	35.2
Approach		462	13.4	0.375	30.4	LOS C	4.8	35.5	0.73	0.72	0.73	39.7
East: SH1												
4	L2	74	10.0	0.518	43.4	LOS D	8.8	69.5	0.93	0.79	0.93	35.6
5	T1	327	18.3	0.518	37.7	LOS D	8.8	71.2	0.93	0.78	0.93	36.9
6	R2	88	11.9	0.301	45.8	LOS D	3.9	29.9	0.92	0.77	0.92	33.9
Approach		489	15.9	0.518	40.0	LOS D	8.8	71.2	0.93	0.78	0.93	36.1
North: Matakana Link Road												
7	L2	89	28.2	0.087	8.3	LOS A	0.9	7.4	0.30	0.62	0.30	51.5
8	T1	131	10.5	0.236	41.3	LOS D	2.9	21.9	0.92	0.71	0.92	35.9
9	R2	195	8.1	0.499	43.2	LOS D	8.5	63.5	0.93	0.81	0.93	34.8
Approach		415	13.2	0.499	35.1	LOS D	8.5	63.5	0.79	0.73	0.79	37.8
West: SH1												
10	L2	248	14.0	0.188	6.8	LOS A	1.6	12.8	0.22	0.61	0.22	52.9
11	T1	318	22.2	0.420	36.8	LOS D	6.8	56.6	0.91	0.74	0.91	37.5
12	R2	146	19.4	0.522	47.9	LOS D	6.7	54.9	0.96	0.80	0.96	33.2
Approach		713	18.8	0.522	28.6	LOS C	6.8	56.6	0.68	0.71	0.68	40.5
All Vehicles		2079	15.8	0.522	33.0	LOS C	8.8	71.2	0.77	0.73	0.77	38.7

MOVEMENT SUMMARY

Site: 101 [Matakana Link Road - Western Link Road_PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Western Link Road - North												
1	L2	178	18.9	0.164	9.3	LOS A	2.2	18.0	0.37	0.65	0.37	51.0
2	T1	313	4.4	0.544	43.7	LOS D	7.3	52.9	0.97	0.79	0.97	35.1
3	R2	172	6.7	0.532	46.8	LOS D	7.8	57.8	0.96	0.81	0.96	33.5
Approach		662	8.9	0.544	35.2	LOS D	7.8	57.8	0.81	0.75	0.81	37.8
East: SH1												
4	L2	97	8.7	0.530	44.3	LOS D	8.6	68.4	0.94	0.79	0.94	34.9
5	T1	285	24.4	0.530	38.7	LOS D	8.6	68.4	0.94	0.78	0.94	36.4
6	R2	54	25.5	0.154	40.2	LOS D	2.1	18.3	0.84	0.73	0.84	35.6
Approach		436	21.0	0.530	40.1	LOS D	8.6	71.1	0.93	0.78	0.93	36.0
North: Matakana Link Road												
7	L2	120	7.9	0.110	9.3	LOS A	1.5	11.2	0.37	0.64	0.37	51.2
8	T1	175	3.6	0.303	41.8	LOS D	3.9	28.1	0.93	0.73	0.93	35.7
9	R2	129	13.0	0.419	45.9	LOS D	5.8	44.8	0.93	0.79	0.93	33.9
Approach		424	7.7	0.419	33.9	LOS C	5.8	44.8	0.77	0.72	0.77	38.4
West: SH1												
10	L2	388	5.7	0.289	7.2	LOS A	3.4	24.9	0.27	0.63	0.27	52.8
11	T1	353	11.6	0.458	37.9	LOS D	7.7	59.0	0.92	0.76	0.92	37.1
12	R2	206	12.8	0.545	43.8	LOS D	9.1	70.8	0.94	0.81	0.94	34.6
Approach		947	9.4	0.545	26.6	LOS C	9.1	70.8	0.66	0.72	0.66	41.5
All Vehicles		2469	11.0	0.545	32.5	LOS C	9.1	71.1	0.77	0.74	0.77	38.9

Woodcocks Road/Wider Western Link

MOVEMENT SUMMARY

Site: 101 [Woodcocks Road - Wider Western Link Road_AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wider Western Link Road												
1	L2	32	10.0	0.152	3.7	LOS A	0.8	6.1	0.16	0.58	0.16	52.2
3	R2	187	10.7	0.152	9.4	LOS A	0.8	6.1	0.16	0.58	0.16	53.8
Approach		219	10.6	0.152	8.6	LOS A	0.8	6.1	0.16	0.58	0.16	53.6
East: Woodcocks Road												
4	L2	273	5.4	0.202	3.5	LOS A	1.3	9.8	0.14	0.40	0.14	56.0
5	T1	45	0.0	0.202	3.5	LOS A	1.3	9.8	0.14	0.40	0.14	57.9
Approach		318	4.6	0.202	3.5	LOS A	1.3	9.8	0.14	0.40	0.14	56.2
West: Woodcocks Road												
11	T1	75	0.0	0.080	4.4	LOS A	0.4	3.2	0.38	0.48	0.38	55.6
12	R2	23	13.6	0.080	10.4	LOS B	0.4	3.2	0.38	0.48	0.38	55.4
Approach		98	3.2	0.080	5.8	LOS A	0.4	3.2	0.38	0.48	0.38	55.6
All Vehicles		635	6.5	0.202	5.6	LOS A	1.3	9.8	0.18	0.47	0.18	55.2

MOVEMENT SUMMARY

Site: 101 [Woodcocks Road - Wider Western Link Road_PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wider Western Link Road												
1	L2	29	3.6	0.276	3.9	LOS A	1.7	12.5	0.27	0.59	0.27	51.7
3	R2	357	8.0	0.276	9.7	LOS A	1.7	12.5	0.27	0.59	0.27	53.3
Approach		386	7.6	0.276	9.2	LOS A	1.7	12.5	0.27	0.59	0.27	53.1
East: Woodcocks Road												
4	L2	186	5.6	0.184	3.6	LOS A	1.2	9.0	0.20	0.39	0.20	55.7
5	T1	89	0.0	0.184	3.6	LOS A	1.2	9.0	0.20	0.39	0.20	57.6
Approach		276	3.8	0.184	3.6	LOS A	1.2	9.0	0.20	0.39	0.20	56.3
West: Woodcocks Road												
11	T1	49	0.0	0.087	5.3	LOS A	0.5	3.7	0.53	0.60	0.53	54.2
12	R2	39	18.9	0.087	11.5	LOS B	0.5	3.7	0.53	0.60	0.53	53.9
Approach		88	8.3	0.087	8.0	LOS A	0.5	3.7	0.53	0.60	0.53	54.1
All Vehicles		751	6.3	0.276	7.0	LOS A	1.7	12.5	0.28	0.52	0.28	54.3

SH1/ Fairwater Road

MOVEMENT SUMMARY

Site: 101vv [SH1 - Fairwater Road_AM Final]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
8	T1	193	3.8	0.127	2.6	LOS A	2.1	15.5	0.25	0.21	0.25	57.6
9	R2	27	11.5	0.263	57.5	LOS E	1.4	10.5	0.99	0.72	0.99	21.8
Approach		220	4.8	0.263	9.4	LOS A	2.1	15.5	0.34	0.27	0.34	51.3
East: Fairwater Road												
10	L2	23	13.6	0.071	40.4	LOS D	0.9	7.3	0.85	0.70	0.85	26.8
12	R2	38	16.7	0.205	49.7	LOS D	1.8	14.0	0.95	0.73	0.95	23.8
Approach		61	15.5	0.205	46.2	LOS D	1.8	14.0	0.91	0.72	0.91	24.8
North: SH1												
1	L2	45	14.0	0.041	12.3	LOS B	0.8	6.1	0.38	0.65	0.38	41.9
2	T1	346	3.6	0.275	6.6	LOS A	6.5	46.7	0.42	0.36	0.42	54.1
Approach		392	4.8	0.275	7.3	LOS A	6.5	46.7	0.41	0.40	0.41	53.1
All Vehicles		673	5.8	0.275	11.5	LOS B	6.5	46.7	0.43	0.39	0.43	49.3

MOVEMENT SUMMARY

Site: 101vv [SH1 - Fairwater Road_PM Final]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
8	T1	319	1.7	0.215	3.6	LOS A	4.4	31.0	0.31	0.27	0.31	56.6
9	R2	28	7.4	0.228	55.8	LOS E	1.4	10.4	0.98	0.72	0.98	30.7
Approach		347	2.1	0.228	7.9	LOS A	4.4	31.0	0.36	0.30	0.36	53.0
East: Fairwater Road												
10	L2	32	13.3	0.080	38.3	LOS D	1.2	9.5	0.82	0.71	0.82	36.0
12	R2	54	9.8	0.219	47.9	LOS D	2.4	18.2	0.92	0.75	0.92	32.9
Approach		85	11.1	0.219	44.4	LOS D	2.4	18.2	0.88	0.73	0.88	34.0
North: SH1												
1	L2	53	10.0	0.049	13.9	LOS B	1.0	7.7	0.42	0.66	0.42	47.5
2	T1	268	5.5	0.227	8.0	LOS A	5.4	39.5	0.45	0.38	0.45	53.0
Approach		321	6.2	0.227	8.9	LOS A	5.4	39.5	0.44	0.43	0.44	52.1
All Vehicles		754	4.9	0.228	12.5	LOS B	5.4	39.5	0.46	0.41	0.46	49.5

SH1/ Western Link -South/ Mckinney Road

MOVEMENT SUMMARY

Site: 101vv [SH1 - Western Link Road South_AM - Final]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
10	L2	343	3.4	0.728	33.6	LOS C	11.5	83.1	0.97	0.88	1.06	37.9
22	T1	180	3.5	0.327	21.6	LOS C	4.9	35.6	0.83	0.68	0.83	44.3
12	R2	91	10.5	0.605	42.3	LOS D	3.3	25.1	1.00	0.81	1.10	34.6
Approach		614	4.5	0.728	31.4	LOS C	11.5	83.1	0.93	0.81	1.00	39.0
East: Collector												
1	L2	82	15.4	0.737	42.3	LOS D	5.4	42.1	1.00	0.89	1.22	35.5
2	T1	65	8.1	0.737	36.6	LOS D	5.4	42.1	1.00	0.89	1.22	36.4
26	R2	35	9.1	0.125	33.9	LOS C	1.1	8.0	0.89	0.72	0.89	37.6
Approach		182	11.6	0.737	38.6	LOS D	5.4	42.1	0.98	0.86	1.16	36.2
North: SH1												
27	L2	37	11.4	0.686	30.9	LOS C	11.6	84.5	0.95	0.84	0.98	41.1
28	T1	329	3.5	0.686	25.2	LOS C	11.6	84.5	0.95	0.84	0.98	42.2
29	R2	4	0.0	0.026	38.5	LOS D	0.1	1.0	0.94	0.64	0.94	36.1
Approach		371	4.3	0.686	25.9	LOS C	11.6	84.5	0.95	0.83	0.98	42.0
West: Western Link Road South												
30	L2	4	0.0	0.301	36.9	LOS D	2.3	17.4	0.95	0.72	0.95	38.8
8	T1	67	7.8	0.301	31.4	LOS C	2.3	17.4	0.95	0.72	0.95	39.5
9	R2	209	5.5	0.738	39.6	LOS D	7.5	55.2	1.00	0.89	1.17	35.8
Approach		281	6.0	0.738	37.6	LOS D	7.5	55.2	0.99	0.85	1.11	36.7
All Vehicles		1447	5.6	0.738	32.1	LOS C	11.6	84.5	0.95	0.83	1.04	38.9

MOVEMENT SUMMARY

Site: 101vv [SH1 - Western Link Road South_PM - Final]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
10	L2	320	2.6	0.323	15.7	LOS B	7.0	49.8	0.60	0.73	0.60	40.8
22	T1	323	1.6	0.829	39.3	LOS D	13.7	97.6	1.00	1.00	1.24	32.5
12	R2	121	7.0	0.774	48.7	LOS D	5.2	38.7	1.00	0.92	1.29	29.7
Approach		764	2.9	0.829	30.9	LOS C	13.7	97.6	0.83	0.87	0.98	35.0
East: Collector												
1	L2	72	22.1	0.494	40.0	LOS D	4.7	37.0	0.96	0.78	0.96	32.6
2	T1	53	6.0	0.494	35.3	LOS D	4.7	37.0	0.96	0.78	0.96	33.0
26	R2	19	5.6	0.084	39.1	LOS D	0.7	5.0	0.91	0.69	0.91	32.2
Approach		143	14.0	0.494	38.2	LOS D	4.7	37.0	0.96	0.77	0.96	32.7
North: SH1												
27	L2	72	4.4	0.786	44.1	LOS D	11.5	84.6	1.00	1.02	1.58	31.9
28	T1	222	6.6	0.786	39.5	LOS D	11.5	84.6	1.00	1.02	1.58	32.1
29	R2	5	0.0	0.032	41.9	LOS D	0.2	1.4	0.94	0.64	0.94	31.5
Approach		299	6.0	0.786	40.6	LOS D	11.5	84.6	1.00	1.01	1.57	32.1
West: Western Link Road South												
30	L2	5	0.0	0.195	29.5	LOS C	3.1	22.4	0.79	0.65	1.06	36.9
8	T1	102	4.1	0.195	25.0	LOS C	3.1	22.4	0.79	0.65	1.06	37.2
9	R2	377	3.4	0.806	37.5	LOS D	14.9	107.3	0.96	0.93	1.13	32.9
Approach		484	3.5	0.806	34.7	LOS C	14.9	107.3	0.92	0.87	1.12	33.8
All Vehicles		1691	4.5	0.829	34.3	LOS C	14.9	107.3	0.90	0.89	1.12	33.9

SH1/ Wider Western Link

MOVEMENT SUMMARY

Site: 101v [SH1 - Wider Western Link Road_AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
1	L2	57	3.7	0.296	6.8	LOS A	2.0	14.2	0.69	0.68	0.69	53.2
2	T1	227	4.2	0.296	7.0	LOS A	2.0	14.2	0.69	0.68	0.69	54.8
Approach		284	4.1	0.296	6.9	LOS A	2.0	14.2	0.69	0.68	0.69	54.5
North: SH1												
8	T1	154	4.1	0.413	3.7	LOS A	3.7	26.8	0.18	0.55	0.18	54.2
9	R2	522	3.8	0.413	9.4	LOS A	3.7	26.8	0.18	0.55	0.18	54.5
Approach		676	3.9	0.413	8.1	LOS A	3.7	26.8	0.18	0.55	0.18	54.4
West: Wider Western Link Road												
10	L2	269	8.2	0.256	4.8	LOS A	1.8	13.4	0.52	0.55	0.52	54.2
12	R2	25	4.2	0.256	10.6	LOS B	1.8	13.4	0.52	0.55	0.52	56.3
Approach		295	7.9	0.256	5.3	LOS A	1.8	13.4	0.52	0.55	0.52	54.4
All Vehicles		1255	4.9	0.413	7.2	LOS A	3.7	26.8	0.38	0.58	0.38	54.4

MOVEMENT SUMMARY

Site: 101v [SH1 - Wider Western Link Road_PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
1	L2	47	0.0	0.321	5.0	LOS A	2.2	15.9	0.54	0.52	0.54	53.9
2	T1	331	2.5	0.321	5.2	LOS A	2.2	15.9	0.54	0.52	0.54	55.5
Approach		378	2.2	0.321	5.2	LOS A	2.2	15.9	0.54	0.52	0.54	55.3
North: SH1												
8	T1	267	4.3	0.362	4.0	LOS A	3.1	23.1	0.32	0.50	0.32	54.9
9	R2	260	10.9	0.362	9.7	LOS A	3.1	23.1	0.32	0.50	0.32	54.9
Approach		527	7.6	0.362	6.8	LOS A	3.1	23.1	0.32	0.50	0.32	54.9
West: Wider Western Link Road												
10	L2	524	5.0	0.540	6.1	LOS A	4.7	34.1	0.74	0.69	0.74	53.4
12	R2	69	0.0	0.540	11.7	LOS B	4.7	34.1	0.74	0.69	0.74	55.5
Approach		594	4.4	0.540	6.7	LOS A	4.7	34.1	0.74	0.69	0.74	53.6
All Vehicles		1499	5.0	0.540	6.4	LOS A	4.7	34.1	0.54	0.58	0.54	54.5

Matakana Road/ Matakana Link Road/ Sandspit Link

MOVEMENT SUMMARY

Site: 101 [Matakana Rd - Sandspit Rd Link _AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Matakana Road												
1	L2	195	4.9	0.343	6.4	LOS A	2.4	17.7	0.68	0.68	0.68	53.5
2	T1	122	14.7	0.343	6.7	LOS A	2.4	17.7	0.68	0.68	0.68	55.0
3	R2	13	0.0	0.343	12.0	LOS B	2.4	17.7	0.68	0.68	0.68	55.6
Approach		329	8.3	0.343	6.7	LOS A	2.4	17.7	0.68	0.68	0.68	54.1
East: Sandspit Road Link												
4	L2	17	0.0	0.230	6.2	LOS A	1.5	10.7	0.65	0.64	0.65	53.1
5	T1	192	1.6	0.230	6.3	LOS A	1.5	10.7	0.65	0.64	0.65	54.7
6	R2	15	0.0	0.230	12.0	LOS B	1.5	10.7	0.65	0.64	0.65	55.0
Approach		223	1.4	0.230	6.7	LOS A	1.5	10.7	0.65	0.64	0.65	54.6
North: Matakana Road												
7	L2	9	0.0	0.320	4.3	LOS A	2.3	17.6	0.42	0.56	0.42	52.8
8	T1	175	9.0	0.320	4.4	LOS A	2.3	17.6	0.42	0.56	0.42	54.1
9	R2	218	13.5	0.320	10.3	LOS B	2.3	17.6	0.42	0.56	0.42	54.1
Approach		402	11.3	0.320	7.6	LOS A	2.3	17.6	0.42	0.56	0.42	54.1
West: Matakana Road Link												
10	L2	185	18.8	0.263	4.6	LOS A	1.8	14.5	0.44	0.52	0.44	53.6
11	T1	68	12.3	0.263	4.5	LOS A	1.8	14.5	0.44	0.52	0.44	55.4
12	R2	59	5.4	0.263	10.1	LOS B	1.8	14.5	0.44	0.52	0.44	55.8
Approach		313	14.8	0.263	5.6	LOS A	1.8	14.5	0.44	0.52	0.44	54.4
All Vehicles		1267	9.6	0.343	6.7	LOS A	2.4	17.7	0.53	0.59	0.53	54.3

MOVEMENT SUMMARY

Site: 101 [Matakana Rd - Sandspit Rd Link _PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Matakana Road												
1	L2	157	6.0	0.309	5.6	LOS A	2.1	15.8	0.61	0.60	0.61	53.6
2	T1	146	6.5	0.309	5.6	LOS A	2.1	15.8	0.61	0.60	0.61	55.2
3	R2	20	0.0	0.309	11.2	LOS B	2.1	15.8	0.61	0.60	0.61	55.7
Approach		323	5.9	0.309	5.9	LOS A	2.1	15.8	0.61	0.60	0.61	54.4
East: Sandspit Road Link												
4	L2	16	0.0	0.125	6.5	LOS A	0.8	5.8	0.68	0.65	0.68	53.0
5	T1	84	6.3	0.125	6.7	LOS A	0.8	5.8	0.68	0.65	0.68	54.5
6	R2	7	0.0	0.125	12.2	LOS B	0.8	5.8	0.68	0.65	0.68	54.9
Approach		107	4.9	0.125	7.0	LOS A	0.8	5.8	0.68	0.65	0.68	54.3
North: Matakana Road												
7	L2	20	0.0	0.428	6.1	LOS A	3.2	24.5	0.72	0.72	0.72	51.6
8	T1	171	6.8	0.428	6.4	LOS A	3.2	24.5	0.72	0.72	0.72	53.0
9	R2	221	13.3	0.428	12.3	LOS B	3.2	24.5	0.72	0.72	0.72	52.9
Approach		412	10.0	0.428	9.6	LOS A	3.2	24.5	0.72	0.72	0.72	52.9
West: Matakana Road Link												
10	L2	228	7.8	0.474	4.8	LOS A	4.1	29.8	0.55	0.55	0.55	53.2
11	T1	232	0.9	0.474	4.7	LOS A	4.1	29.8	0.55	0.55	0.55	55.0
12	R2	141	1.5	0.474	10.5	LOS B	4.1	29.8	0.55	0.55	0.55	55.3
Approach		601	3.7	0.474	6.1	LOS A	4.1	29.8	0.55	0.55	0.55	54.4
All Vehicles		1443	6.1	0.474	7.1	LOS A	4.1	29.8	0.62	0.62	0.62	53.9

Sandspit Road/ Sandspit Link

MOVEMENT SUMMARY

Site: 101 [Sandspit Rd - Sandspit Rd Link _AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Sandspit Road												
5	T1	453	3.3	0.407	4.1	LOS A	3.4	24.5	0.39	0.46	0.39	55.5
6	R2	120	1.8	0.407	9.8	LOS A	3.4	24.5	0.39	0.46	0.39	55.8
Approach		573	2.9	0.407	5.3	LOS A	3.4	24.5	0.39	0.46	0.39	55.5
North: Sandspit Link												
7	L2	58	12.7	0.150	5.5	LOS A	0.9	6.7	0.53	0.65	0.53	51.8
9	R2	102	1.0	0.150	10.9	LOS B	0.9	6.7	0.53	0.65	0.53	53.8
Approach		160	5.3	0.150	8.9	LOS A	0.9	6.7	0.53	0.65	0.53	53.0
West: Sandspit Road												
10	L2	46	2.3	0.278	4.1	LOS A	1.9	14.9	0.37	0.42	0.37	54.7
11	T1	312	13.9	0.278	4.3	LOS A	1.9	14.9	0.37	0.42	0.37	56.2
Approach		358	12.4	0.278	4.3	LOS A	1.9	14.9	0.37	0.42	0.37	56.0
All Vehicles		1091	6.4	0.407	5.5	LOS A	3.4	24.5	0.41	0.48	0.41	55.3

MOVEMENT SUMMARY

Site: 101 [Sandspit Rd - Sandspit Rd Link _PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Sandspit Road												
5	T1	414	7.6	0.331	3.7	LOS A	2.7	19.9	0.23	0.40	0.23	56.3
6	R2	88	4.8	0.331	9.4	LOS A	2.7	19.9	0.23	0.40	0.23	56.6
Approach		502	7.1	0.331	4.7	LOS A	2.7	19.9	0.23	0.40	0.23	56.4
North: Sandspit Link												
7	L2	135	0.8	0.172	5.8	LOS A	1.1	7.5	0.60	0.64	0.60	53.4
9	R2	41	0.0	0.172	11.5	LOS B	1.1	7.5	0.60	0.64	0.60	55.4
Approach		176	0.6	0.172	7.1	LOS A	1.1	7.5	0.60	0.64	0.60	53.9
West: Sandspit Road												
10	L2	120	0.9	0.374	4.0	LOS A	2.8	20.2	0.33	0.40	0.33	55.0
11	T1	419	3.3	0.374	4.0	LOS A	2.8	20.2	0.33	0.40	0.33	56.6
Approach		539	2.7	0.374	4.0	LOS A	2.8	20.2	0.33	0.40	0.33	56.3
All Vehicles		1217	4.2	0.374	4.7	LOS A	2.8	20.2	0.33	0.44	0.33	56.0

Wider Western Link/ Link to the Southern Interchange

MOVEMENT SUMMARY

Site: 101v [Link to the Southern Interchange - Wider Western Link Road_AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wider Western Link Road												
1	L2	218	8.7	0.339	4.8	LOS A	2.4	18.0	0.51	0.51	0.51	54.2
2	T1	199	2.1	0.339	4.9	LOS A	2.4	18.0	0.51	0.51	0.51	56.1
Approach		417	5.6	0.339	4.9	LOS A	2.4	18.0	0.51	0.51	0.51	55.1
North: Wider Western Link Road												
8	T1	74	2.9	0.219	4.4	LOS A	1.4	10.5	0.40	0.58	0.40	53.6
9	R2	208	5.1	0.219	10.1	LOS B	1.4	10.5	0.40	0.58	0.40	53.8
Approach		282	4.5	0.219	8.6	LOS A	1.4	10.5	0.40	0.58	0.40	53.8
West: Link to the Southern Interchange												
10	L2	113	12.1	0.223	4.7	LOS A	1.5	11.5	0.46	0.59	0.46	52.5
12	R2	147	14.3	0.223	10.6	LOS B	1.5	11.5	0.46	0.59	0.46	54.2
Approach		260	13.4	0.223	8.0	LOS A	1.5	11.5	0.46	0.59	0.46	53.4
All Vehicles		959	7.4	0.339	6.8	LOS A	2.4	18.0	0.46	0.55	0.46	54.2

MOVEMENT SUMMARY

Site: 101v [Link to the Southern Interchange - Wider Western Link Road_PM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wider Western Link Road												
1	L2	151	18.2	0.220	4.2	LOS A	1.5	11.5	0.34	0.42	0.34	54.7
2	T1	145	0.7	0.220	4.1	LOS A	1.5	11.5	0.34	0.42	0.34	56.9
Approach		296	9.6	0.220	4.1	LOS A	1.5	11.5	0.34	0.42	0.34	55.8
North: Wider Western Link Road												
8	T1	209	1.5	0.273	5.3	LOS A	1.9	13.4	0.56	0.59	0.56	54.5
9	R2	100	8.4	0.273	11.1	LOS B	1.9	13.4	0.56	0.59	0.56	54.6
Approach		309	3.7	0.273	7.2	LOS A	1.9	13.4	0.56	0.59	0.56	54.5
West: Link to the Southern Interchange												
10	L2	172	28.2	0.363	4.7	LOS A	2.7	21.9	0.44	0.58	0.44	51.8
12	R2	277	14.8	0.363	10.4	LOS B	2.7	21.9	0.44	0.58	0.44	53.8
Approach		448	20.0	0.363	8.2	LOS A	2.7	21.9	0.44	0.58	0.44	53.0
All Vehicles		1054	12.3	0.363	6.8	LOS A	2.7	21.9	0.44	0.54	0.44	54.2