



## Western Ring Route – Waterview Connection



# Assessment of Temporary Traffic Effects





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## Glossary

<b>AADT</b>	Annual Average Daily Traffic
<b>AEE</b>	Assessment of Environmental Effects (of the Project)
<b>Alternating Flow</b>	Temporary control of a roadway in a single lane with both directions operating in turn. Usually controlled with stop-go traffic control, temporary signals or in limited circumstances with priority (similar to a one-lane bridge).
<b>AM Peak</b>	The morning peak traffic demand period typically experienced between 7am and 9am Monday – Friday in the Auckland region, however in some locations peak spreading extends this to 6am – 10am.
<b>ATA</b>	Auckland Transport Agency – the Council Controlled Organisation that is expected to administer the road network in the Auckland Region following amalgamation of the Auckland councils in 2010.
<b>Bull-Run</b>	A road layout which includes a single lane separated from other lanes in the same direction, often narrowed and / or contra-flowed onto the opposing carriageway and separated by barriers. Typically temporary in nature, it provides opportunities for maintaining the existing number of lanes during works.
<b>CCTV</b>	Closed Circuit Television
<b>COPTTM</b>	Code of Practice for Temporary Traffic Management - The NZTA manual which details how TTM is undertaken on New Zealand roads.
<b>Counter-peak</b>	The period on a corridor that experiences tidal flow conditions where the opposing direction is experiencing peak demands. On SH16, the AM peak is in the eastbound direction (with commuters travelling to the city) and therefore the same period is the counter-peak for SH16 Westbound;
<b>CTMP</b>	Construction Traffic Management Plan – The document developed for the Project and forms a part of the Construction Environmental Management Plan. The CTMP defines the procedures, standards and methodologies required for planning and implementing Temporary Traffic Management (TTM) on the Project.
<b>CMJ</b>	Central Motorway Junction – The motorway to motorway interchange between SH1 and SH16 in central Auckland, broadly defined as the mainline and ramps between Newton Road and Wellesley Street on SH16 and between Gillies Avenue and Cook Street on SH1.
<b>EED</b>	Engineering Exception Decision - The document submitted with the Site Specific Traffic Management Plan for circumstances where proposed temporary traffic management does not conform with the Code of Practice for Temporary Traffic Management.
<b>KPI</b>	Key Performance Indicators – Measures set up for quantitatively monitoring the performance of the Project in accordance with this plan.
<b>Mainline</b>	The continuous part of the motorway corridor (i.e. not on-ramps, off-ramps or motorway to motorway links).
<b>MOTSAM</b>	Manual of Traffic Signs and Markings – The NZTA manual which details how signage and line marking is to be installed on New Zealand roads.
<b>MOTTM</b>	Manual of Temporary Traffic Management - The Auckland City specific manual for requirements for traffic management on the Auckland City road network.

**Point-to-Point Speed Enforcement**

Enforcement of average speed limit over a stretch of road. It is achieved by measuring the time it takes a vehicle to drive between two points and calculating the average speed of vehicle over this length. Point-to-point enforcement promotes area wide suppression of speeding because speed enforcement is sustained over a length of road rather than just a single spot.

<b>RCA</b>	Road Controlling Authority
<b>SSTMP</b>	Site Specific Traffic Management Plan - The plan for approval by the Road Controlling Authority prior to implementation of traffic control on the road network.
<b>TCD</b>	Traffic Control Devices - The rule that will provide guidance on industry good practice, including, where necessary, practice mandated by law in relation to the use of traffic control devices.
<b>PM Peak</b>	The evening peak traffic demand period typically experienced between 5pm and 7pm Monday – Friday in the Auckland region, however in some locations peak spreading and school trips extend this to 3pm – 7pm.
<b>Rat Run</b>	An alternative (and often more circuitous) route used to bypass parts of the network that are congested, typically lower on the road hierarchy than the corridor where the delays are experienced – i.e. a rat run around a district arterial might be on collector or local roads;
<b>Tidal flow</b>	Pattern of traffic flow characterised by a majority of movements in one direction during one period of the day followed by the opposite movement later in the day;
<b>TMU</b>	Traffic Management Unit - The organisation responsible for monitoring and commissioning of traffic signals in the Auckland Region. The TMU was formed as a partnership between NZTA and the city and district councils within the Auckland region;
<b>TMPGG</b>	Traffic Management Project Governance Group – a group established from members from each of the key stakeholders which will monitor project progress and identify issues to be resolved on a regular basis;
<b>TTM</b>	Temporary Traffic Management;
<b>MVMS</b>	Mobile Variable Message Signs – A temporary message signs primarily used to notify road users of work sites, diversion routes, etc;
<b>VMS</b>	Variable Message Signs - Message signs which are fixed, used to inform the road users of work sites, diversion routes, etc;
<b>WRR</b>	Western Ring Route – The continuous motorway connection from SH1 at Manukau City to SH1 Albany via SH20, SH16 and SH18.

## Executive Summary

In 2009 the NZTA confirmed its intention that the Waterview Connection Project ("the Project") would be lodged with the Environmental Protection Authority as a Proposal of National Significance. The Project includes works previously investigated and developed as two separate projects: being the SH16 Causeway Project and the SH20 Waterview Connection. The key elements of the Project are:

- Completing the Western Ring Route (which extends from Manukau to Albany via Waitakere);
- Improving resilience of the SH16 causeway between the Great North Road and Rosebank Interchanges to correct historic subsidence and "future proof" it against sea level rise;
- Providing increased capacity on the SH16 corridor (between the St Lukes and Te Atatu Interchanges);
- Providing a new section of SH20 (through a combination of surface and tunnelled road) between the Great North Road and Maioro Street Interchanges; and
- Providing a pedestrian / cycle way throughout the surface road elements of the Project corridor.

This Assessment of Temporary Traffic Effects (ATTE) provides an initial appraisal of the traffic impacts arising from construction of the Project. It proposes measures to mitigate the identified impacts where appropriate, however it is expected that traffic impacts will primarily be managed in accordance with the Waterview Connection Construction Traffic Management Plan (CTMP), which forms part of the Construction Environmental Management Plan (CEMP) suite of documents.

This assessment has been developed based on the anticipated form of construction activities and traffic methodologies that will be necessary to facilitate the Project works. The construction methodology will be better defined when construction contracts are awarded.

As such, this assessment assesses the general impacts of the activities which will later require some greater level of refinement to satisfy stakeholders and road controlling authorities in accordance with the CTMP. The CTMP will cover the traffic management principles for the Project as a whole, with Site Specific Traffic Management Plans (SSTMP) being developed at a time closer to construction commencing which will show the actual traffic management plan to mitigate each construction sequence.

Accordingly it is expected that the temporary traffic management activities identified in this assessment will be refined during the SSTMP development stage. As such, this assessment should be read in conjunction with the CTMP and remainder of the Construction Environmental Management Plan

The full extent and scope of the works of the Project have been reviewed in preparation of this assessment and stage-by-stage traffic management methodologies have been developed on a sector by sector basis. The construction activities and required traffic management activities for each of the sectors have been assessed for their expected traffic impacts and mitigation measures proposed.



The Project assignment and operational traffic models have both been employed in understanding the impacts of construction on the road network, with an assessment of the effect on travel times along SH16, diversion arising from reduction in capacity on the motorway and Great North Road, and the effects of night time diversions all considered using these tools. This has shown that the effects of the works on SH16 are likely to be experienced in the surrounding road network. However, these are assessed to be at a “business as usual” level when compared to other recent and current motorway projects. These effects are readily managed as exemplified on current NZTA projects including the Newmarket Viaduct, Victoria Park Tunnel and Manukau Harbour Crossing Projects.

A summary of expected impacts for SH16 and along the future alignment of SH20 are presented. Comprehensive mitigation strategies are proposed for these routes, particularly for SH16 where it is anticipated that much of the 7km between St Lukes Interchange and Te Atatu Interchange will be affected, and at times may be affected concurrently. This can be expected to have impacts across the Auckland strategic road network and it is therefore essential that these impacts are well understood and methods developed to mitigate or minimise their effect.

In particular, it is anticipated that a number of site accesses will be required along SH16, and careful management of these accesses will be necessary to minimise the effect of construction traffic on road users. It will also be necessary to remove the bus lanes on SH16 during part of the construction works and as such it is expected there will be some impact on travel times for bus services during the stages that this occurs. It is currently anticipated that the bus lanes will be affected for around 5 or 6 months, but will be reinstated as soon as practicable. The existing northwestern cycle way along SH16 will remain operational throughout the works and therefore the impacts on pedestrians and cyclists along SH16 are anticipated to be minimal.

The staged construction of the cut-and-cover tunnel beneath Great North Road is anticipated to have an impact on travel times along Great North Road as there will be a significant number of site access movements to and from the construction yards to the east and west of the project area. It is also anticipated that existing signals at the intersection of Great North Road and Herdman Street will need to undergo some modifications to manage access to the project during construction.

The scale of the identified impacts is highly sensitive to the construction programme and traffic conditions at the time of construction. It is because of this current uncertainty that the requirements, procedures and standards for managing the effects have been developed and documented in the CTMP, and through this process it will be possible to mitigate the impacts identified within this assessment.

In general the effects outlined in this assessment are expected to be able to be mitigated acceptably provided the procedures outlined by the CTMP are followed. The effects are not anticipated to be significantly greater or unusual compared with other major road construction projects completed in the Auckland region in the last five to ten years. As such, the NZTA has considerable experience and a strong track record of successfully managing the effects of construction on traffic that will be carried through into the Waterview Connection Project.



## 1. Introduction

In 2009 the NZTA confirmed its intention that Waterview Connection Project (“the Project”) would be lodged with the Environmental Protection Authority as a Proposal of National Significance. The Project includes works previously investigated and developed as two separate projects: being the SH16 Causeway Project and the SH20 Waterview Connection. The key elements of the Project are:

- Completing the Western Ring Route (which extends from Manukau to Albany via Waitakere);
- Improving resilience of the SH16 causeway between the Great North Road and Rosebank Interchanges to correct historic subsidence and “future proof” it against sea level rise;
- Providing increased capacity on the SH16 corridor (between the St Lukes and Te Atatu Interchanges);
- Providing a new section of SH20 (through a combination of surface and tunnelled road) between the Great North Road and Maioro Street Interchanges; and
- Providing a pedestrian / cycle way throughout the surface road elements of the Project corridor.

This assessment provides an appraisal of the traffic impacts arising from construction of the Project and associated temporary traffic management methodologies. It proposes measures to mitigate the identified impacts, where possible. In general it is expected that traffic impacts will primarily be managed in accordance with the Waterview Connection - Construction Traffic Management Plan (CTMP), attached in **Appendix A**, which forms part of the Construction Environmental Management Plan (CEMP) suite of documents.

This assessment has been developed based on the anticipated form of construction activities and traffic methodologies that will be necessary to facilitate the Project works. The broad staging and programme of work is well understood at this time, and this traffic effects assessment during construction has been developed on that basis. This provides an appreciation of the network wide level effects, effects on key roading corridors and, in some cases, the effects on sensitive areas which have been developed to a greater level of certainty. These kinds of effects include:

- Effects of lane narrowing and temporary speed limits on roadway capacity;
- Effects of road closures and likely detour and diversion scenarios;
- Effects of site access and movement;
- Effects on significant passenger transport and pedestrian and cycling facilities.

The construction methodology will be refined following award of construction contracts and once contractors refine the methodology to the work. More detailed traffic management work is undertaken exclusively at the construction stage of the Project when site specific details are better understood.

As a result, this assessment does not generally provide a quantitative analysis of the traffic impacts during construction; instead, it assesses the general impacts of the activities which will later require more specific refinement to satisfy stakeholders and road controlling authorities in accordance with the CTMP.

Procedures for the planning, management, operation and monitoring of traffic control, which applies to all the activities noted above, can be found in the CTMP in Appendix A. As such, this assessment should be read in conjunction with the CTMP and the Construction Environmental Management Plan (CEMP). The CTMP outlines the standards, methodologies and procedures necessary to mitigate the traffic impacts of construction and the associated traffic management methodologies adopted for the Project. The CEMP provides a more detailed description of the construction activities involved in the Project and procedures for how these will be managed.

It is expected that the temporary traffic management activities identified in this assessment will be refined during the Site Specific Traffic Management Plan (SSTMP) development stage, at a time closer to construction commencing. At that time, the specific impacts of each activity at that stage will be better understood and detailed mitigation strategies will be able to be developed and implemented.

While this assessment discusses physical works which will form part of the temporary works, it is important to note that it does not prescribe or limit the activities that may become part of the final design.

The Project has been divided into 9 sectors, based on the specialist design and construction expertise required for the separate areas. For the extent of the sectors, please refer to the sector diagram, which can be found in the AEE documentation.

## 1.1 Other Reports

The main transport assessment is documented in Technical report G.18: *Assessment of Transport Effects*.

There are a number of technical reports which support the Transport Assessment undertaken for this project. These are as follows:

- Technical Report G.26: *Operational Model Validation Report*;
- Technical Report G.25: *Traffic Modelling Report*.

This assessment is Technical Report G.16: *Assessment of Temporary Traffic Effects*. It appraises the traffic impacts of the construction of the Project.

## 2. Environmental performance standards and specifications

Temporary Traffic Management (TTM) is governed by New Zealand legislation, in particular, the Land Transport Act 1998. Land Transport Rules made pursuant to that Act, which relate to TTM, include:

- Land Transport (Road User) Rule 2004
- Land Transport Rule: Traffic Control Devices 2004
- Land Transport Rule: Setting of Speed Limits 2003

NZTA's Traffic Control Devices Manual (TCD Manual) provides guidance on industry good practice, including, where necessary, practice mandated by law in relation to the use of traffic control devices. The primary standard (which forms part of the TCD Manual) that will be adhered to in planning, coordinating and implementing TTM for this Project is COPTTM (including the local road supplement and RCA-specific procedures).

The TCD Manual includes and will supersede previous stand alone documents relevant to TTM, such as the Code of Practice for Temporary Traffic Management (COPTTM) and the Manual of Traffic Signs and Markings (MOTSAM). NZTA's State Highway Geometric Design Manual (Draft) also provides design standards and procedures for the State motorway work.

For further information on the standards, procedures and guidelines necessary for implementation of temporary traffic management on the Project please refer to the CTMP.

### 3. Traffic Management Activities and Impacts

This section describes the generic traffic management activities and the associated impacts that are expected to arise from the construction of this Project.

The high-level staging and programme of work is well understood at this time and this assessment has been developed on that basis. It provides a basis for understanding the network wide level effects, effects on key corridors and in some cases the effects on sensitive areas which have already been assessed to a greater level of detail.

Detailed site-specific work on traffic management measures and mitigation measures cannot be confirmed until construction is to commence on site so they can best meet the needs of stakeholders, affected parties and the needs of construction. This assessment therefore reflects the best understanding of likely traffic management methodologies for the required construction works, and is based on similar road construction activities across the Auckland region.

The impacts of the traffic control activities described in the following sections can be broken up into six broad categories, which are included in Table 3.1 below. The six categories of impacts generally arise from a number of traffic management activities, which are also shown.

**Table 3.1 - Summary of Impacts and Traffic Control Activity**

Impact Category	Traffic management activity
<b>1. Impacts on capacity of existing carriageways</b>	<ul style="list-style-type: none"> <li>- Shoulder Narrowing</li> <li>- Lane Narrowing</li> <li>- Lane realignment</li> <li>- Temporary speed limit</li> </ul>
<b>2. Temporary closures of existing carriageways</b>	<ul style="list-style-type: none"> <li>- Lane closure - alternating flow operation</li> <li>- Lane closure - contra-flow operation</li> <li>- Lane closure - one-direction closure</li> <li>- Road closure / detour</li> <li>- On-ramp and off-ramp closures/ detour</li> <li>- Short term closures for installation of long-term closures / traffic control measures</li> <li>- Temporary speed limit</li> <li>- Intersection part closure (which may include installation of lane closures on the approaches to the intersection to safely divert traffic around the works).</li> <li>- Intersection full closure (which may include installation of full closures on the approaches to the intersection to safely divert traffic around the works).</li> </ul>
<b>3. Impacts arising from site access locations and movements</b>	<ul style="list-style-type: none"> <li>- Site access from a local road or motorway</li> <li>- Mobile escorted entry / exit manoeuvres</li> </ul>

Impact Category	Traffic management activity
<b>4. Impacts on public transport provision</b>	<ul style="list-style-type: none"> <li>- Bus lane closures/ detours</li> <li>- Bus Stop closures/ relocations</li> </ul>
<b>5. Impacts on pedestrians, cyclists, and mobility routes or crossings</b>	<ul style="list-style-type: none"> <li>- Footpath closure/ detours</li> <li>- Temporary footpath realignment and narrowing</li> <li>- Pedestrian crossing closure</li> <li>- Cycle lane closures / detours</li> <li>- Temporary pedestrian / cycle way realignment and narrowing</li> </ul>
<b>6. Impacts on property access, parking, and manoeuvring</b>	<ul style="list-style-type: none"> <li>- Roadside car parking closures</li> <li>- Property access closures</li> <li>- Reduction/ closure of manoeuvring area</li> </ul>

## 4. Overview of Project Structure and Programme

The Project has been divided into 9 sectors, based on the specialist design and construction expertise required for the separate areas. For the extent of the sectors, please refer to the sector diagram, which can be found in the main body of the AEE.

Each sector has a range of specialist activities that will be undertaken by a combination of disciplines and construction methodologies. Each of these activities will require a unique traffic management approach to facilitate works, and can be broadly described as follows:

### 1. Sector 1 – Te Atatu Interchange

The works in Sector 1 are primarily associated with widening of existing overbridge structures and widening and realignment of the motorway and the ramps connecting to Te Atatu Road. This work will be undertaken offline under a combination of temporary road realignments and night time closures. For further detail of the construction methodology, traffic management methodology, impacts and proposed mitigation measures, refer to **section 7** below.

### 2. Sector 2 – Whau River Bridge

Work in Sector 2 is limited to motorway bridge widening on the existing structure over the Whau River, east of the Te Atatu Interchange. This work will be undertaken offline over five stages of temporary road realignments and a number of night time lane closures. For further details refer to **section 8** below.

### 3. Sector 3 – Rosebank Terrestrial

Sector 3 works include widening of the existing motorway alignment and replacement of the existing northwestern cycle way bridge. This work will primarily be undertaken offline under a combination of temporary road realignments and night time closures. For further details refer to **section 9** below.

### 4. Sector 4 – Reclamation

Work in Sector 4 includes reclamation (raising and widening of the causeway) of SH16 and widening of the existing causeway bridges. This work will mostly be undertaken offline under temporary road realignments. For further details refer to **section 10** below.

### 5. Sector 5 – Great North Road Interchange

The works in Sector 5 include construction of the new ramps connecting SH16 and SH20 and widening or realignment of the existing on and off-ramps. This work will primarily be undertaken under night closures for erection of structures over the motorway, and several minor realignments on SH16 to



facilitate work on the median and on the shoulders for tie-ins to the new ramps. For further details refer to **section 11** below.

6. Sector 6 – SH16 to St Lukes

Sector 6 works are limited to widening of the existing SH16 east and westbound carriageways, and will be completed mostly under minor motorway realignments similar to widening activities seen between Market Road and Green Lane West Interchange on SH1 in 2010. For further details refer to **section 12** below.

7. Sector 7 – Great North Road Underpass

Works in Sector 7 are associated with the cut-and-cover Great North Road underpass. The work in this section will be undertaken under a combination of temporary realignments of Great North Road and a number of night time closures. For further details refer to **section 14** below.

8. Sector 8 – Avondale Heights Tunnel

Sector 8 works are associated with construction of the bored Avondale Heights Tunnel, which will be undertaken offline and accessed from Sectors 7 and 9. For further details refer to **section 15** below.

9. Sector 9 – Alan Wood Reserve

Sector 9 includes motorway extension works through the existing Alan Wood Reserve between the to-be-completed Maoro Interchange in the south and the southern portal of the Avondale Heights Tunnel to the north. This work will primarily be undertaken off-line, however several realignments will be necessary on Richardson Road. For further details refer to **section 16** below.

## 5. Traffic Modelling

Traffic modelling has been undertaken for assessment of the traffic effects during construction of the Project. Both the operational traffic model and project assignment traffic model have been used as part of this assessment, and both have been specially modified for a scenario year of 2014, which is currently expected to be about half way through the Project programme.

For further detail of the assumptions that were applied in the 2014 scenario, refer to Technical Report G.25: *Traffic Modelling Report* in which section 4 details the network assumptions and land use growth used in the 2016 model. It is acknowledged that a number of the projects listed in section 4 of the traffic modelling report are not guaranteed to be complete by 2014. Projects for which construction programmes have not been confirmed that are included in the 2014 scenario include AMETI Stage 1 and Penlink; however the changes in traffic patterns arising from these projects are not expected to materially affect the conclusions and analysis outlined in this assessment.

For further details of the assumptions and validation of the operational traffic model, please refer to Technical Report G.26: *Operational Model Validation Report*.

### 5.1 Scenarios Tested

#### 5.1.1 Operational Traffic Model

One scenario was tested in the operational traffic model, which was developed to assess the effects of the construction activities (particularly lane narrowing and temporary speed limits) on the performance of SH16 and Great North Road.

The scenario tested was as follows:

- 80kph temporary speed limit between on SH16 St Lukes and Te Atatu Road interchange;
- Narrowed lanes (3.25m wide) and shoulders (0.5m wide) on SH16 in both directions between St Lukes and Te Atatu Road interchange;
- 30kph temporary speed limit on Great North Road between Alford Street and Waterview interchange;
- Narrowed lanes (3.25m wide) and shoulders (0.5m wide) on Great North Road in both directions between Alford Street and Waterview interchange;

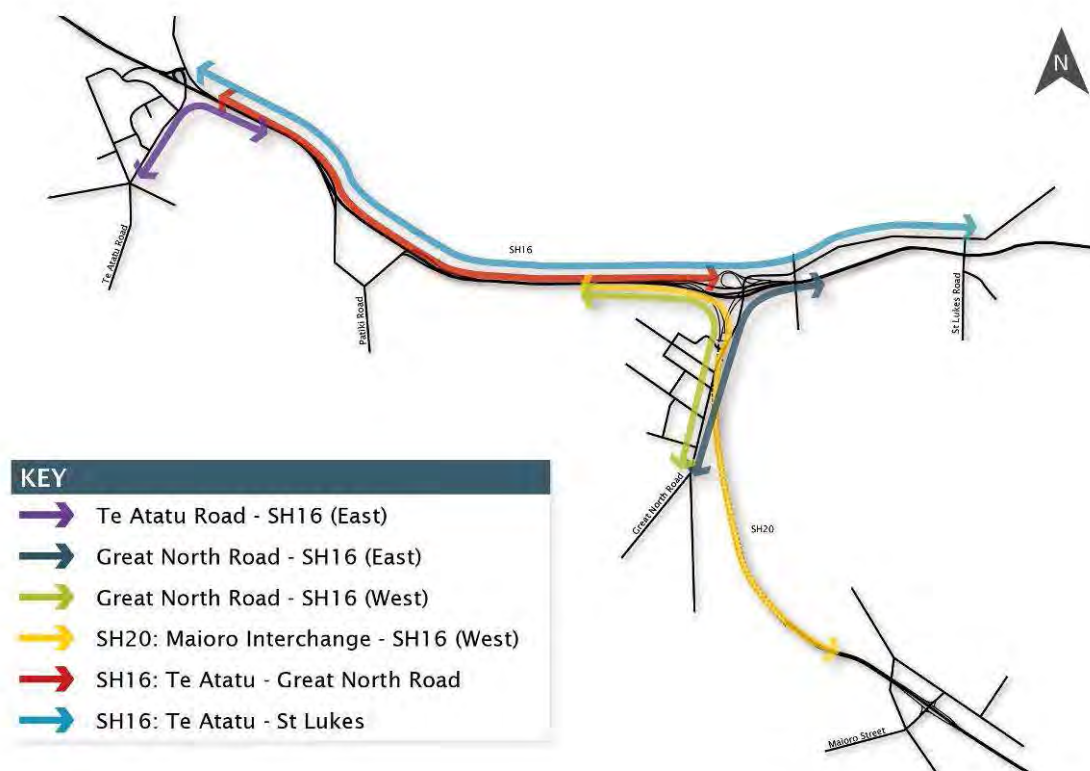
- Modification of the Great North Road / Herdman Street intersection to accommodate construction traffic movements from an additional leg.

This scenario tests the 'worst case' arrangement of traffic management across the entire Project to enable a conservative approach to estimating the effects of the Project on the network. In particular, it is likely that not all of SH16 will be continuously and concurrently narrowed and have a temporary speed limit applied throughout the works. The model assumes this is the case and therefore is likely to overestimate the effect of the traffic management effects during any one portion of the works.

Travel times on a number of routes were sourced from the model, and are provided where applicable in **section 6.1.3** below:

- SH16 Westbound between St Lukes and Westgate (mainline only)
- SH16 Eastbound between Westgate and St Lukes (mainline only)
- SH16 Westbound (St Lukes Interchange) to Great North Road (Blockhouse Bay Road)
- Great North Road (Blockhouse Bay Road) to SH16 Westbound (Westgate)
- SH16 Eastbound (west of Great North Road Interchange) to Great North Road (Blockhouse Bay Road)
- Great North Road (Blockhouse Bay Road) to SH16 Eastbound (east of Great North Road Interchange)
- SH16 Westbound (St Lukes Interchange) to Te Atatu Road (Edmonton Road)
- Te Atatu Road (Edmonton Road) to SH16 Westbound (Westgate)
- SH16 Eastbound Westgate to Te Atatu Road (Edmonton Road)
- Te Atatu Road (Edmonton Road) to SH16 Eastbound (St Lukes Interchange)

**Figure 5-1** below indicates these routes.



**Figure 5-1 - Operational Model Travel Time Routes**

Results of the operational traffic modelling undertaken for the assessment of traffic effects on SH16 are discussed in **section 6.1.3** below.

### 5.1.2 Assignment Traffic Model

Two forms of tests were conducted in the project assignment traffic model, where one set tested the network effects of reduction in capacity on SH16 and Great North Road, while the second set tested what traffic is likely to be affected by night time closures.

Assessment of the effects of lane narrowing on key corridors such as SH16 and Great North Road was achieved through implementation of a 10% reduction in the capacity of the affected links which can be expected to approximate the effect of construction activities on the network through diversion and additional delays. Difference plots comparing the 'base' 2014 model to the result from the capacity reduction are shown and discussed where applicable.

Select link analyses were used to determine the scope of effects arising from night time closures on the network. In general, night time flows have been estimated using the interpeak model. This has been chosen on the basis that interpeak flows are less affected by commuter traffic and therefore tend to be more widely distributed in their origin and destinations than AM and PM peak models. Select links allow identification of

the trips that will be affected by night works and therefore assist in determining how to best communicate with the public and mitigate the effects of the activity.

It is important to note that the modelling undertaken for this assessment will be an input into the qualitative analysis of the effects of the required traffic management methodologies to allow the development of appropriate mitigation strategies. As is noted in the CTMP and discussed in this assessment, this assessment of effects has been developed on the basis of the broad construction staging and programme.

This assessment provides a preliminary appraisal of the scope of the effects on the road network. Methods for mitigating these impacts will be refined and developed as part of the process detailed in the CTMP.

## 6. Overview of SH16 Traffic Impacts and Proposed Strategic Mitigation Measures

This section describes at a high level the impacts that can be expected on SH16 as a result of the Project, and proposes a number of mitigation strategies that will assist in developing a coherent response to the impacts. This is necessary, as many of the road users that pass through the Project area will experience many of the same impacts irrespective of the activity being undertaken within the construction sites.

The Project includes the length of SH16 from Henderson Creek, west of Te Atatu to the St Lukes Interchange, in Western Springs. The SH16 works generally involve widening the motorway in each direction (between Great North Road Interchange and Te Atatu Interchange) and the upgrade of Te Atatu Interchange. The Project also includes the connection of SH20 to SH16 at the Great North Road Interchange, through the construction of four additional ramps. The Project includes six sectors of work along SH16, namely the Te Atatu Interchange, Whau River Bridge, Rosebank, Reclamation, Great North Road Interchange, and SH16 to St Lukes.

The traffic management methodology adopted for achieving these works typically involves the use of a number of realignments of SH16 with associated lane and shoulder narrowing to create off-line work zones. In the widening activities to the west of Great North Road Interchange, the motorway alignment will initially be shifted to the south, then north, then to the left hand side of either direction to create the required work zones. The motorway will be realigned under lane closures at night. The works to interchange ramps and local roads will follow a similar methodology, by realigning traffic lanes under night closures. The interchange ramps will be closed over night to complete some works. Bus shoulders, footpaths, and cycle lanes through the project area will be closed during some phases.

Impacts from the traffic management methodology generally arise from the temporary road realignments, short term road closures, presence and use of site accesses, closure of bus shoulder lanes and effects on pedestrian and cyclist facilities. The impacts will affect both the efficiency and safety of SH16 and thus will require careful management of the effects to minimise the effects on users of the corridor. The major traffic management impacts affecting road users are as follows:

1. Reduced traffic capacity arising from narrowed lanes and shoulders.
2. 80km/hr speed limit along significant stretches of SH16 at any one time, potentially for the full length of the site between St Lukes and Te Atatu Interchanges. This will however depend on the staging of the works and will be agreed with NZTA and NZTA's network maintenance consultant in advance of the works commencing.
3. Site access movements with associated impact on roadway capacity due to higher number of vehicles, slowed traffic during escorted access manoeuvres and higher proportion of trucks on the roadway as a result of site activities.

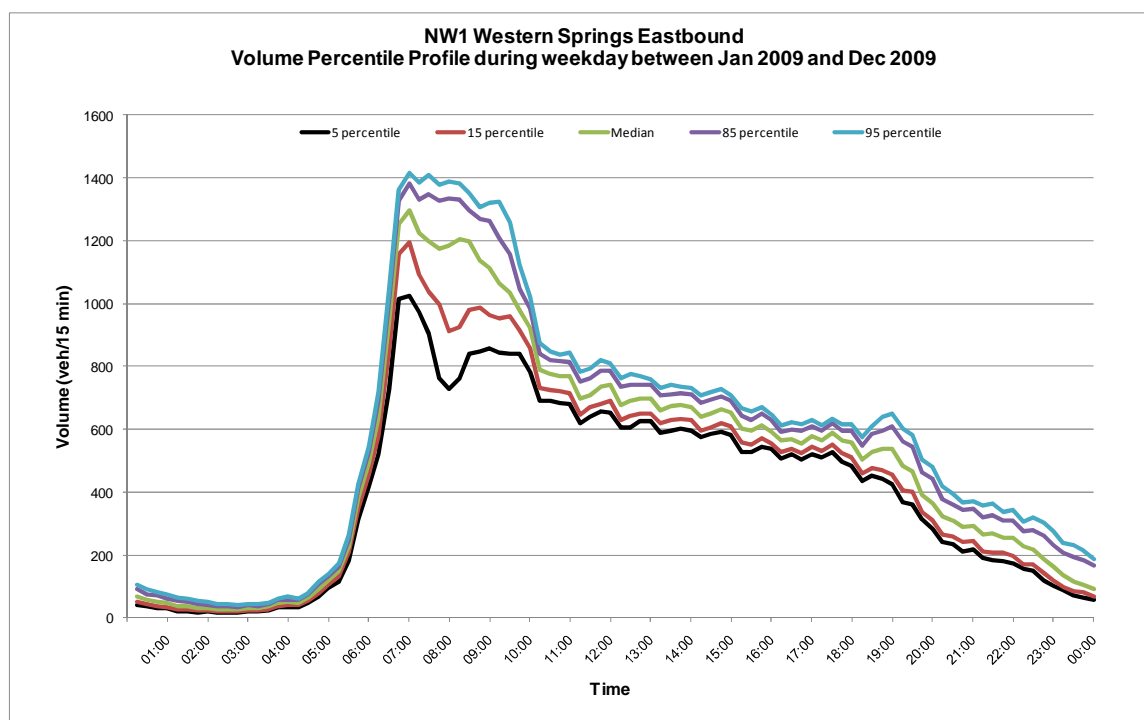
### 6.1.1 Existing Traffic Flows

To understand the likely impact on traffic flows on SH16, it is necessary to understand the traffic flow patterns on the corridor.

This section provides an overview of the existing traffic flow profiles, based on flows sourced from the Auckland Motorway Alliance from 2009. Each figure shows the 5<sup>th</sup>, 15<sup>th</sup>, 85<sup>th</sup> and 95<sup>th</sup> percentile flows along with the median, which provides an indication of the variability of flows on the segment described, and can be used to illustrate the risks associated with a proposed traffic management methodology such as lane closures or full closures.

The graphs shown below are based on daily flow profiles gathered over an entire year (with holiday periods removed) and therefore the weekday profile reflects the variability in traffic across approximately 240 days. Thus the effects of varying demands on the network across the course of the year, is reflected in the varying profiles between the various percentiles.

**Figure 6-1** below indicates the eastbound traffic flow profile at Western Springs, at the extreme eastern end of the Project area.



**Figure 6-1 - SH16 Eastbound Flow Profile at Western Springs**

This figure indicates the tidal nature of the flows on SH16, which in the eastbound direction experiences a pronounced AM peak between the hours of 06:00 and 10:00 as commuter traffic approaches Auckland City.

The effects of peak spreading can be observed in the median, 85<sup>th</sup> and 95<sup>th</sup> percentile profiles with the profile flattening out and demands remaining high until later in the morning. If peak spreading was not occurring, a similar shaped profile to the lower percentile flows would be expected. However, the profile of the demands flattens out as the capacity of the corridor is reached in the median and 85<sup>th</sup> percentile and 95<sup>th</sup> percentile flows.

This peak spreading indicates that demands on SH16 eastbound exceed capacity on parts of the network in the vicinity of Western Springs in the AM peak. The implication for the effects of construction activities on traffic is that small reductions in the capacity of the parts of the corridor that are at capacity will result in greater impacts than parts of the corridor that are not. Parts of the corridor that are at capacity are typically at bottlenecks, for example at on-ramps (where ramp traffic merges with mainline traffic without additional lanes), lane drops (where the number of lanes reduces) or at off-ramps (if queues from the arterial network extend back onto the mainline).

On SH16 eastbound for the extent of the project, the main bottlenecks exist at the following locations:

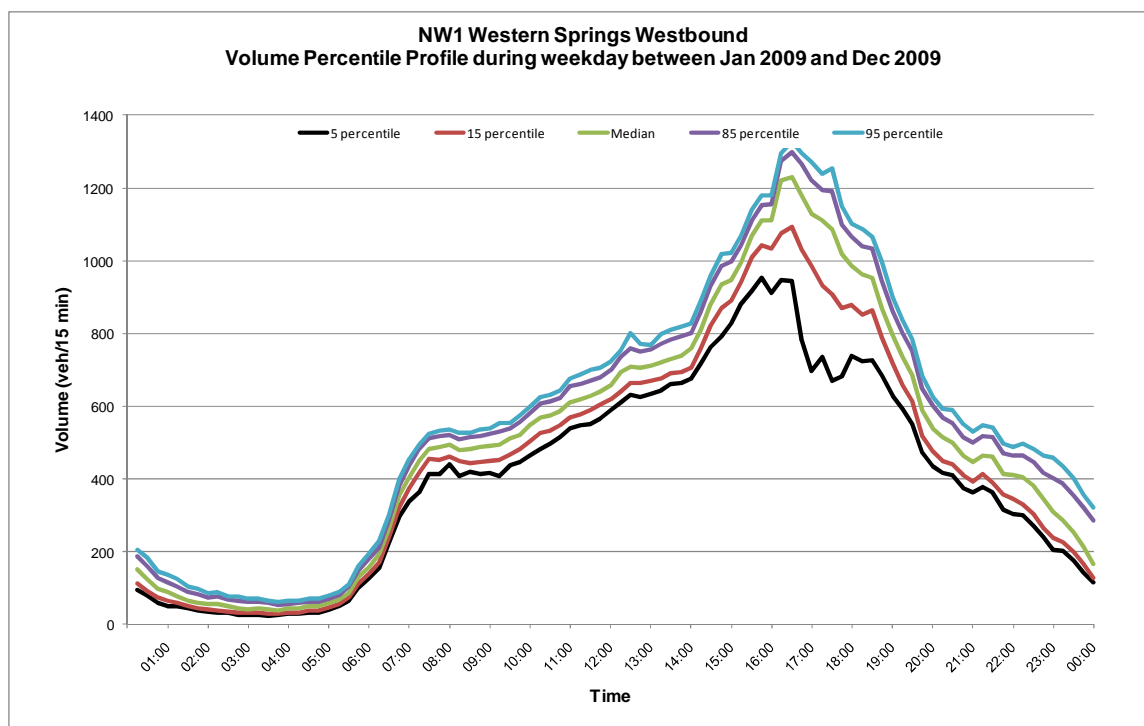
- Te Atatu Interchange eastbound on-ramps;
- Rosebank Road on-ramp;
- Great North Road eastbound on-ramp; and
- Western Springs interchange eastbound off and on-ramps.

These locations will need to be managed carefully in staging the works of the project, and each is discussed in more detail in the following sections of this assessment.

Following 10:00am, traffic volumes on SH16 eastbound typically drop in an approximately linear fashion, with an isolated peak observed after 6pm.

**Figure 6-2** below indicates the traffic flow profile at Western Springs, at the extreme eastern end of the Project area.





**Figure 6-2 – SH16 Westbound Flow Profile at Western Springs**

This figure reinforces the tidal nature of the flows on SH16, however as is typically observed across the Auckland region, the PM peak is spread across a number of hours between around 14:00 and around 19:00, and is not as pronounced as the AM peak. This is because the PM peak is comprised of traffic that is staggered across a wider period (with school and the traditional work day ending at different times), and road users typically have a greater flexibility in the time they begin their trip.

The effects of peak spreading are not pronounced in any of the profiles provided, however the 5<sup>th</sup> percentile flows show a dip at around 16:30 which reflects congested conditions on the motorway and arterial networks constraining the number of vehicles passing through western springs.

In the AM peak, 10:00am, traffic volumes typically drop in an approximately linear fashion, with an isolated peak observed after 6pm.

Typically, the tidal nature of SH16 means that construction activities will need to be curtailed in the peak direction only, and opportunities may exist to allow closures (such as lane closures, mobile closures or semi-static closures) in the counter-peak direction under limited circumstances.

### 6.1.2 Expected Changes to Traffic Flow

This section provides a brief overview of the expected changes in traffic flow that are likely to occur between the preparation of this assessment and commencement of construction on site for the Project. It is a

qualitative assessment and does not attempt to quantify or estimate the magnitude of the effects of these changes on the impacts outlined in this assessment. For further details of the expected changes to traffic flow, and the operation of the road network following the completion of the Waterview Connection and WRR, refer to Technical Report G.18: *Assessment of Transport Effects* and Technical Report G.25: *Traffic Modelling Report*.

The changes outlined in this section are incorporated in the traffic modelling undertaken for the temporary traffic management assessment outlined in latter sections of this assessment.

Several significant changes to the motorway network are expected to change traffic flows on SH16 between now and the commencement of work on the Project, as follows:

- Completion of the Newmarket Viaduct Replacement Project and associated additional southbound lane between Gillies Avenue Interchange and Green Lane West Interchange;
- Completion of the Victoria Park Tunnel Project, which will provide an additional northbound lane between the Port and Northwest to North Link On-Ramp (just south of Wellington Street On-Ramp) and the Auckland Harbour Bridge, and two additional southbound lanes between Fanshawe Street and the North to Port and Northwest Off-Ramps (just south of the Cook Street Off-Ramp);
- Completion of the Lincoln Road Interchange works, which will provide additional capacity for both the westbound and eastbound carriageways on SH16;
- Completion of the SH16 Hobsonville Deviation, providing a more direct and high-speed link to SH18 and bypass of the existing congested intersection of SH16 and Hobsonville Road at Westgate.

Each of these improvements are expected to release key strategic bottlenecks to the east and west of the Project area. However, the release of these bottlenecks is not expected to have a material effect on the peak traffic demands on SH16 between Central Motorway Junction (CMJ) and Lincoln Road.

In the case of the Hobsonville Deviation and Lincoln Road interchange, easing congestion to the northwest of the project area will provide lower travel times and release queues on the approach to the Project area along SH16 eastbound. While this could result in higher peak demands through the Project area, it is expected the ramp signalling system will be employed to manage demands and capacity across the eastbound bottlenecks outlined in **section 6.1.1** above and therefore the effect is considered to be minimal and adequately accounted for in the models developed for the Project.

In the case of the Victoria Park Tunnel Project, the southbound movement through the Victoria Park Viaduct on SH1 is constrained at present and therefore it can be expected latent demand will be released as result of the extra capacity. However, the southbound to westbound movement (via the North to Northwest Link) is not a particularly high-demand movement at present (with approximately 750 veh/hour in the PM peak) and therefore the effect of the release of the Victoria Park Viaduct bottleneck is not expected to materially effect the peak profile of SH16 westbound and it can be expected it is adequately accounted for in the models developed for the project.

Newmarket Viaduct Replacement Project improves capacity southbound and is therefore likely to provide some relief to delays on SH16 eastbound on the approach to CMJ in the AM and PM peaks.

### 6.1.3 Impact on SH16 Capacity of Temporary Layout

As noted previously, the major traffic management methodology that will be employed for completing construction works on SH16 will be realignment and narrowing of SH16 with installation of temporary barriers to facilitate works to occur off line where possible. This narrowing and realignment will be coupled with the installation of a temporary speed limit, which is currently expected to be 80 km/hr.

It is acknowledged that reduced speed limits through motorway construction sites where construction zones are protected by temporary barrier systems have limited effect on reducing the speed of motorway traffic. As such, the temporary speed limits will require development of enforcement strategies, appropriate traffic calming measures and extensive road user education to be effective. Consideration could also be given to implementation of point-to-point speed enforcement as part of the works, which provides a high level of compliance, however the feasibility of such a scheme is yet to be proven in New Zealand. In any case it is anticipated that a comprehensive speed management approach will be developed to minimise the risk to workers and road users and will be conducted in accordance with the CTMP.

This kind of activity has been successfully implemented to facilitate construction works in many locations across the state motorway network in Auckland in the past 10 years. Examples include:

- CMJ Stage 1: Construction works undertaken in an extremely narrow corridor on the busiest stretch of motorway in the country (with around 200,000 vehicles per day at the time), which included very narrow lanes (as narrow as 3.1m) and implementation of a 'bull-run' which contra-flowed northbound traffic onto the southbound carriageway for a significant period during the works;
- CMJ Stage 2: Construction works undertaken in the country's busiest and most complex motorway interchange, required lane narrowing to 3.25m in many locations and included SH16 between St Lukes and Newton Road. Nearly 20km of lane narrowing was implemented throughout the works with minimal impact on capacity during construction;
- Newmarket Connection Project: Narrowing of more than 3km of SH1 southbound to 3.1m lanes direction with 70 kph temporary speed limits and high-intensity work sites adjacent to temporary barriers;
- Victoria Park Tunnel Project: Narrowing of nearly 2.5km of SH1 to 3.1m lanes with 70 kph temporary speed limits adjacent to Victoria Park Viaduct which is one of the most congested bottlenecks in New Zealand;
- Manukau Harbour Crossing Project: Narrowing of nearly 5km of SH20 to 3.1m lanes with 80 kph temporary speed limit over a section of road that experiences extreme recurrent congestion in both the AM and PM peak.

While this methodology of lane narrowing and installation of temporary work sites has been implemented a number of times, the proposed length along SH16 during the causeway works (at nearly 7km) is unprecedented in the Auckland Region. However, as noted earlier, it is unlikely that all the activities on SH16 will be undertaken concurrently, and there will be a respite in the narrowing through the Great North Road interchange where only localised (and shorter timeframe) narrowing will be necessary for construction of the ramps that connect to SH20.

Experience on the above projects indicates the impacts to motorway capacity as a result of narrowing and temporary speed limits could result in a reduction of approximately 10%, however this is highly dependent on a number of variables as follows:

- Work site intensity, which affects the amount of ‘rubber-necking’ and distraction by passing road users. This distraction results in successive road users slowing to observe activities occurring in the site, which also affects the following distances left by each road user;
- Downstream capacity of motorway and arterial network, which can dictate whether the reduction in capacity on the carriageway affected by the works actually is a constraint on throughput. If narrowing is implemented in a location that is congested due to downstream bottlenecks, the capacity of the affected section will not affect the overall performance of the network during congested periods. Due to the tidal nature of SH16, the flows in the AM and PM peak are sensitive to the performance of downstream bottlenecks which are currently highly congested. For example, significant congestion presently occurs in the AM peak on SH16 eastbound as a result of constraints in CMJ and at Great North Interchange, while in the PM peak congestion occurs as a result of congestion on Te Atatu Road, Lincoln Road and at Westgate. This congestion typically means that traffic would queue back through the project area in the existing situation, and therefore narrowing would have little effect on overall network performance. The performance of SH16 during construction and temporary traffic management activities will be affected by the following factors:
  - The speed of vehicles entering the project area, which affects the amount of braking that will be necessary to adjust to the change in road environment;
  - The geometric standard and layout of the road, which lane narrowing has potential to affect capacity by lessening the length of merges and diverges;
  - Effect of reduced sight distance, which can increase following distances and thereby reduce capacity;
  - Presence, location and frequency of use of site accesses;
  - Presence and location of shoulders for vehicle breakdowns and management of incidents.

Each of these factors can be expected to play a part in the performance of SH16 during the works, however the magnitude of each of these factors converging is difficult to predict at this time. Lane narrowing and temporary speed limits were applied in the operational traffic model to determine the impact on travel times arising from the construction activities.

The following results shown in **Table 6.1** were gained from the modelling.

**Table 6.1 – Effect of SH16 Lane Narrowing on SH16 Travel Times**

Route	AM (minutes:seconds)			PM (minutes:seconds)		
	Base	Scenario <sup>1</sup>	% Change	Base	Scenario	% Change
<b>Great North Road</b> (Blockhouse Bay Road) <b>to SH16 Eastbound</b> (east of Great North Road)	07:13	09:51	37%	07:55	06:07	-23%
<b>Great North Road</b> (Blockhouse Bay Road) <b>to SH16 Westbound</b> (west of Great North Road)	05:51	08:35	47%	06:39	06:03	-9%
<b>SH16 Westbound</b> (east of Great North Road) <b>to Great North Road</b> (Blockhouse Bay Road)	02:54	03:36	24%	03:11	03:53	22%
<b>SH16 Eastbound</b> (west of Great North Road) <b>to Great North Road</b> (Blockhouse Bay Road)	03:55	04:36	17%	04:29	05:46	29%
<b>SH16 Eastbound between Te Atatu and Great North Road Interchanges</b> (mainline only)	09:29	09:36	1%	03:36	03:53	8%
<b>SH16 Westbound between Great North Road and Te Atatu Interchanges</b> (mainline only)	03:40	03:58	8%	09:15	11:20	22%
<b>SH16 Eastbound between Te Atatu and St Lukes Interchanges</b> (mainline only)	13:05	11:30	-12%	05:18	05:43	8%
<b>SH16 Westbound between St Lukes and Te Atatu Interchanges</b> (mainline only)	05:35	05:59	7%	12:57	15:01	16%
<b>Te Atatu Road</b> (Edmonton Road) <b>to SH16 Eastbound</b> (east of Te Atatu Road)	11:43	12:38	8%	03:41	09:49	167%
<b>SH16 Westbound</b> (East of Te Atatu Road) <b>to Te Atatu Road</b> (Edmonton Road)	02:45	02:53	5%	03:22	03:41	9%

<sup>1</sup> The scenario is described in **section 5.1.1**

This shows that the lane narrowing can be anticipated to have some impact on the travel times along SH16, and in particular the routes that include Great North Road and Te Atatu Road. This indicates that the work at the interchanges and on the arterial network is likely to have the greatest impact on the network performance from a road user perspective. Special attention will need to be given to mitigating the effects of construction works on Great North Road and Te Atatu Road.

The highest travel time impact is anticipated to occur on Te Atatu Road northbound along the route from Edmonton Road and connecting to SH16 Eastbound, which is estimated to result in approximately 6 minutes additional travel time in the PM peak. Review of the operational model indicates that the temporary speed limit at the interchange has a significant effect on the operation of the signals, as the existing coordination of the signals is based upon a 50 kph speed limit.

In order to mitigate this impact, the coordination of the signals will need to be reviewed in light of the 30 kph temporary speed limit to optimise capacity through the interchange. It is expected this would reduce the predicted increase on travel times significantly.

In addition to the signal optimisation, extensive communications and road user education may need to be undertaken before works begin on Te Atatu Interchange and on SH16 eastbound east of Te Atatu Interchange. This might include incentivising public transport through the project area and recommendations of alternative routes that are not as affected.

A reduction in travel times is observed in the model for the following routes:

- Great North Road to SH16 Eastbound in the PM peak, for which it is predicted there will be a 23% improvement in travel times. Travel times on the other SH16 eastbound movements are shown to increase by between 8 and 29%, which indicates the effect of lane narrowing on SH16 is constraining flow to the west of the route observed between Great North Road and SH16 Eastbound. This constraint in flow results in lower demands through the route described above, delivering an expected reduction in travel time, as is predicted;
- Great North Road to SH16 Westbound in the PM peak, for which it is predicted there will be a 9% improvement in travel times. Travel times on the other SH16 Westbound movements are shown to increase by between 16% and 22%, which appears to contradict the 9% improvement in travel times on the route mentioned above. However, the improvements in the travel times for northbound movements on Great North Road noted in the bullet above indicates that improvements in eastbound movements on SH16 releases constraints on Great North Road which off-set the disbenefits of construction activities to the west along SH16;
- SH16 eastbound Te Atatu interchange to St Lukes interchange, for which it is predicted there will be a 12% reduction in travel times. The SH16 eastbound Te Atatu interchange to Great North Road interchange indicates a 1% increase in travel times, which means that it can be inferred that the improvement in travel times will occur on SH16 between Great North Road and St Lukes interchange. The cause of this improvement can be traced to the change in travel times on Great North Road northbound in the AM peak, which increase by between 37% and 47%. This increase in travel times on Great North Road shows that

flows on Great North Road will be constrained in the AM peak and therefore SH16 to the east of the interchange is likely to receive some benefit.

It is important to note that the changes in travel times noted above are based on a scenario that includes all temporary work sites implemented concurrently along SH16 and Great North Road. Therefore the figures quoted above will be a conservative estimate of the effects of the works on the network. As such, it is expected that the travel time effects on Te Atatu Road and other corridors will be able to be managed and reduced to less than the COPTTM requirement of inducing no greater than 5 minute delays.

It will be necessary for NZTA's appointed contractor to develop detailed mitigation strategies in accordance with the CTMP and as part of the SSTMP development process.

#### 6.1.4 Wider Network Effects

In addition to the effect of the temporary work activities on SH16 traffic, it can be expected that a reduction in capacity will result in diversion away from SH16 onto the arterial network.

A number of scenarios have been investigated in the project assignment traffic model, which is capable of predicting the re-routing of traffic based on the increased travel times arising from the changes to SH16. The testing was conducted in a 2014 scenario, which is currently expected to be approximately half way through the construction programme, and includes network improvements such as the Hobsonville Deviation, Victoria Park Tunnel and Newmarket Connection.

For the purposes of the assignment traffic model scenarios, a 10% reduction in capacity was assumed, which allows for a qualitative assessment of the effects to be developed. The results of this modelling are contained in a sub-section within each of the remaining sections, which describes the traffic management methodology for each sector, and has the title "Impacts arising from the temporary work site", which detail the expected diversion effects arising from a capacity reduction on each of the sections of SH16.

It is important to note, however, that the modelling results contained in this assessment are likely to exaggerate the effects of the capacity reduction. As noted previously, a 10% reduction has been applied in the model to provide an indication of the likely range of effects, however a Highway Capacity Manual (HCM) analysis of the lane narrowing has indicated this is likely to be closer to 4% and in some locations can be expected to be negligible as the capacity of the motorway is often constrained by downstream bottlenecks. The effects of this have not been explicitly considered in the analysis contained in this assessment; therefore as discussed previously the analysis is conservative.

In summary, capacity reductions on SH16 are expected to have some effects in adjoining local authority networks (Auckland and Waitakere) that are served by the motorway system. The effects will be felt in the immediate vicinity of the affected section, particularly where there are feasible alternative routes that provide similar travel times for road users – these will typically result in increases in traffic volumes on Great North Road, New North Road, Rosebank Road and Meola Road. However where there are not feasible alternative routes there tend to be wider network effects observed, this is particularly observed in the area around Te

Atatu Interchange and Whau River Bridge, where diversion routes are required to navigate all the way around the Whau River onto Great North Road and other congested alternative routes. As is discussed in the following sections, particular care will need to be taken in dealing with traffic in these areas and efforts made to minimise the effects on capacity throughout the works.

Proposed strategic mitigation measures for SH16 for each of the impacts arising from these diversions can be found in section 6.1.6. Further detail of the impacts associated with each of the sectors along SH16 can be found in section 7 onwards.

### 6.1.5 Impacts arising from temporary closures

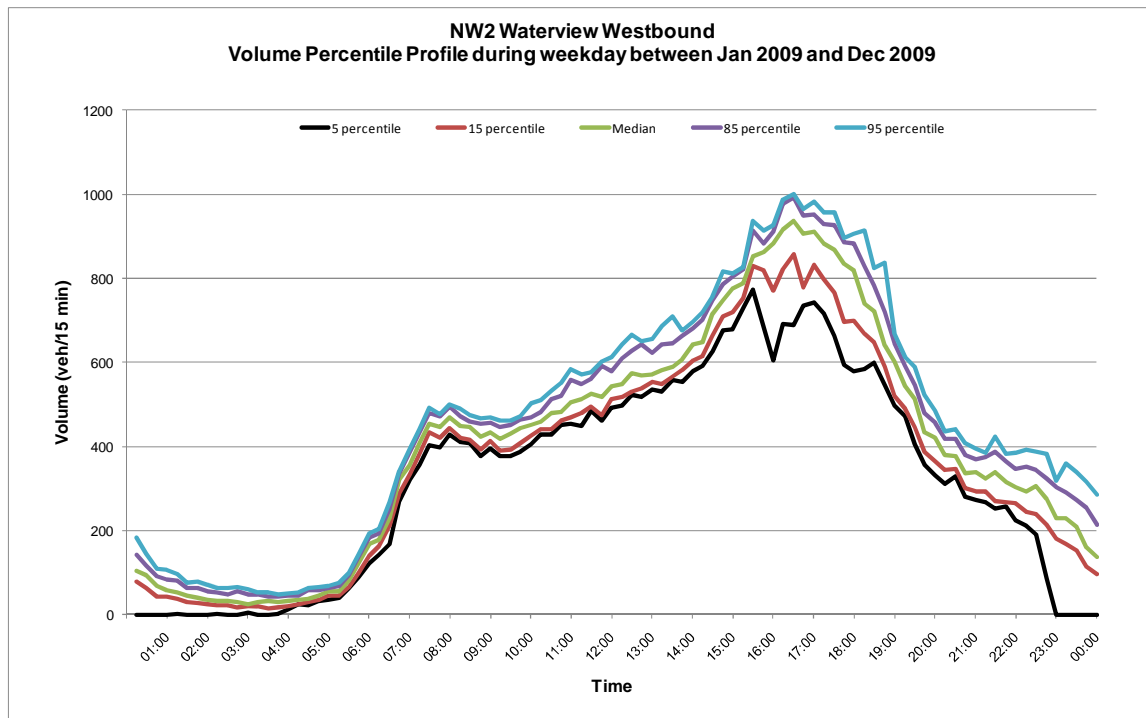
It is expected that a number of lane closures on SH16 will be necessary for facilitating construction works throughout the Project. These activities may require one or two (depending on the existing number of lanes and the activity) lanes to be closed at any one time. Lane closures will typically be implemented at night following easing of traffic demands after the PM peak.

Lane closures will be planned by the NZTA's appointed contractor so that traffic demands can be accommodated by the remaining capacity following the closure of lanes.

COPTTM specifies that lanes through a closure require a capacity of 1,500 vehicles per hour, and that a lane into which two lanes have merged upstream requires a capacity of 1,300 vehicles per hour. This means that a single lane closure on a two lane motorway will have a capacity of 1,300 vehicles per hour (as two lanes merge to one), while a single lane closure on a three lane motorway will have a capacity of 2,800 veh / hr (as two lanes merge to one = 1,300 veh / hr + one unaffected lane = 1,500 veh / hr = 2,800 veh / hr total capacity).

To provide an example of the typical closure times that might be implemented to facilitate works, **Figure 6-3** below indicates the flow profile observed on SH16 Westbound at the Great North Road Interchange.





**Figure 6-3 – SH16 Westbound Flow Profile at Great North Road Interchange**

In this location there are three westbound lanes (west of the SH16 Westbound Great North Road off-Ramp). Therefore, there needs to be no more than 2,800 veh / hr passing through this location in order to close a lane, or 700 vehicles per fifteen minutes (as shown on the scale in the above figure). In this case, it would be acceptable to close one lane between the hours of 20:00 and midday the following day. However unless specific approval was sought for an extended closure it would be expected that the closure would be lifted at 05:30 in line with the policy applied by NZTA's network maintenance consultant in scheduling of road closures.

This relatively simple approach using COPTTM capacities and flow profiles will be used in development of SSTMPs in accordance with the CTMP. Where sufficient data is available, 85<sup>th</sup> percentile flows will be used in determining the appropriate time for the closure.

By using the above approach, the impacts to traffic flow arising from lane closures are expected to be minimal. As there would be sufficient capacity remaining on the carriageway for the traffic demands, queues and delays would not be expected. If closure times were necessary for longer periods, a greater level of analysis would be required and this would be conducted in consultation with project stakeholders and in accordance with the CTMP. Further detail of the types of closures, including full closures of the motorway, that will be required in each sector are contained in the sections below.

### 6.1.6 Mitigation Strategy

This section proposes a possible suite of mitigation measures that could be implemented for minimising the traffic effects of construction activities on SH16.

Not only is it difficult to predict the impact of construction activities on the capacity of roadways and the possible diversion effects, it is also difficult to predict the effectiveness of mitigation measures. As such the proposed mitigation measures outlined in this section would be developed in consultation with affected stakeholders once the full scope and programme of the construction activities are understood, in accordance with the CTMP.

A potential mitigation strategy for minimising the effects of the works on SH16 might include:

- Use of overhead VMS messaging on SH1 north and southbound and SH16 east and westbound in advance of significant changes to the road layout or capacity. The messaging strategies will take into account the strategic nature of trips that use SH16, and therefore extend across the Auckland region's road network to SH1 and SH20 where necessary. This will include messaging in advance of the changes to pre-condition motorists to the changes, and messaging during or shortly after works to minimise the safety risks;
- Recommendation and optimisation of alternative routes to minimise the overall network delay caused by the works on SH16, particularly on Great North Road, New North Road, Meola Road and Rosebank Road;
- Implementation of point-to-point speed enforcement (PPSE) on SH16, legislative and judicial requirements permitting. Implementation of PPSE internationally has shown significant safety benefits for construction sites, with an extremely high proportion of vehicles adhering to the speed limit following implementation, leading to a safer and more reliable road environment.
- Close liaison with passenger transport agencies and operators to determine the impact of changes to the provision of bus lanes on passenger transport services and development of appropriate mitigation measures including additional services, refinement of timetables and dissemination of passenger information;
- Close liaison with major traffic generating activities and sites and sensitive stakeholders in the area, for example Unitec and local schools;
- Communication campaigns aimed at diverting traffic onto alternative routes and minimising the level of demand through the project area;
- Integration with employer travel plans to recommend alternative routes, modes or travel times to minimise the demand on the road network.

## 7. Sector 1 - Te Atatu Interchange

The remainder of this assessment details the traffic management methodologies necessary to complete works in each of the nine sectors of the Project. Each section provides an overview of the traffic management methodology, an appraisal of the likely traffic management impacts, and proposes a preliminary mitigation strategy where necessary.

For clarity, the first instance of an activity that will result in traffic impacts is **bolded** so that it is easier for the reader to refer between sections within each sector discussion.

### 7.1 Preliminary Traffic Management Methodology

The upgrade of the Te Atatu Interchange and SH16 widening are planned to be constructed under three phases. Each phase is expected to **realign and narrow the lanes and ramps of SH16** through temporary pavement markings and installation of safety barriers to open up work zones to allow off-line construction. An **80km/hr temporary speed limit** will be installed for the length of the road affected by temporary narrowing and realignment.

**The left hand shoulder / bus lane will be closed** during a limited period of the works programme to maximise the work zones, whilst a **temporary pedestrian / cycle way** will be maintained. **Site access** to the work site will be established off Te Atatu Road and potentially the Te Atatu Interchange Eastbound On-Ramp.

The widening and lowering of SH16 will be undertaken over four phases of mainline and ramp realignments with associated lane and shoulder narrowing. Initially, works on the shoulders of the SH16 carriageways (i.e. the outside of the motorway alignment) will be completed, which will allow works to be completed in the median. During the works, lanes on SH16 will generally be narrowed to a minimum of 3.35m (measured from centre line to centreline of pavement markings) and shoulders to a minimum of 0.3m, and 0.5m where possible. Where shoulder narrowing is implemented, opportunities for providing emergency stopping bays for incidents, breakdowns and emergency services will be investigated and implemented where they can be facilitated by the work site.

Work on the westbound Te Atatu Road Off-Ramp will be undertaken off-line and as a result will have little impact on the motorway, while work on the remaining ramps (eastbound on-ramps and off-ramp, westbound on-ramp) will require a staged approach with lane narrowing and minor realignments necessary to completed the works.

The existing number of lanes on the mainline and on the ramps will remain operational throughout works, with the exception of closure of one lane on the approach to the ramp meter on Te Atatu Road loop on-ramp.

Works on the Te Atatu Interchange bridge widening will be undertaken over four phases so that the existing functionality and lanes in the interchange will be maintained throughout the works. Necessary work on the bridges over SH16 or in the live lanes will be conducted **during night closures of SH16 and Te Atatu Road** under an approved site-specific traffic management plan (SSTMP).

Wherever lane narrowing or realignment is implemented to facilitate offline construction activities, temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary for site access from the motorway. Temporary lighting will be installed behind the barrier to maintain the existing lighting level to the motorway.

The works on the interchange will be staged from the site compound accessed from Te Atatu Road, north of SH16. Site accesses to the compound will be designed and managed to minimise the effect on the road network, which will be agreed with the RCA in a SSTMP prior to start of works.

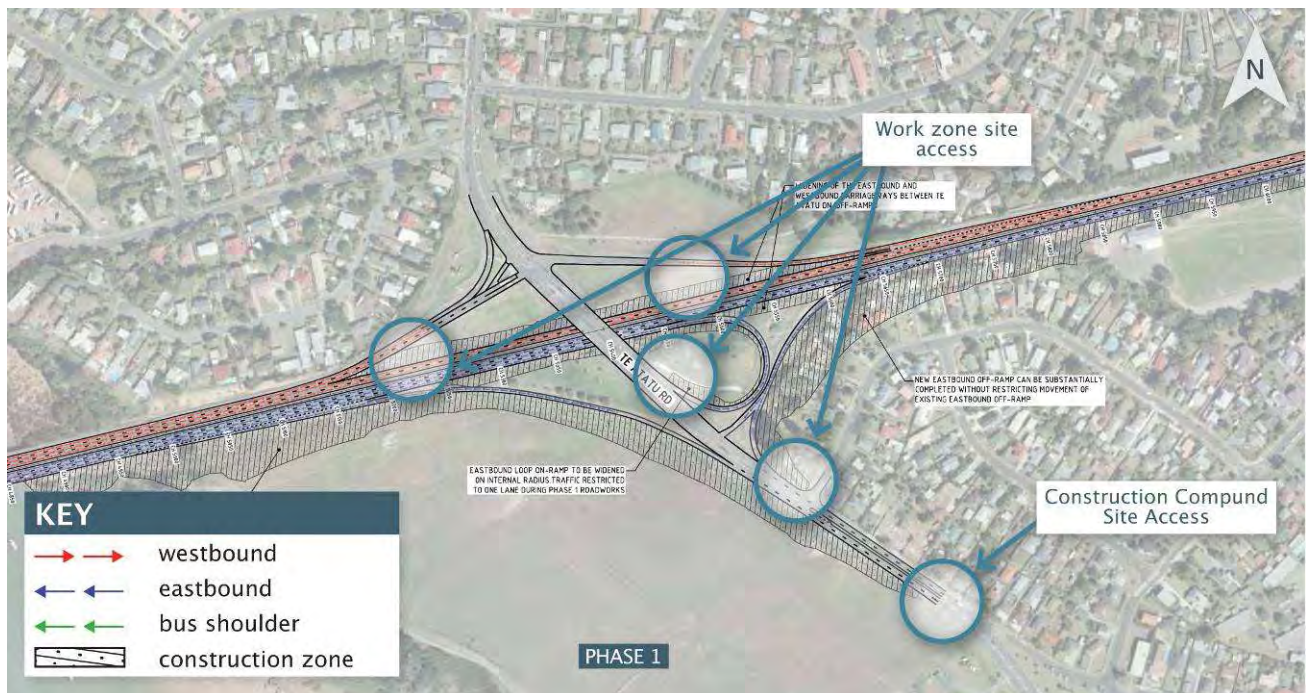
A number of drawings have been prepared showing the construction methodology employed in Sector 1, which are the basis for the description outlined in this section.

#### 7.1.1 Phase 1

A feasible methodology for Phase 1 of the Te Atatu Interchange upgrade might include:

- The widening on the north side of SH16, between Henderson Creek and the Whau Bridge;
- The widening on the north side of SH16 in the eastbound direction and south side in the westbound direction between the on and off ramps;
- The widening on the northern side of the Te Atatu Interchange Eastbound On-Ramp;
- Widening on the inside of the Te Atatu Interchange Eastbound Loop On-Ramp;
- The widening of the Te Atatu Interchange Eastbound Off-Ramp.

The traffic management methodology for this phase is indicated in **Figure 7-1** below.



**Figure 7-1 – Te Atatu Interchange Traffic Management Methodology Phase 1**

The construction compound site (construction yard no. 1) for the Te Atatu Interchange upgrade will be located in an area to the north-east of the Te Atatu Interchange and will be accessed off Te Atatu Road. A right turn bay will be marked on the Te Atatu Road median for vehicles turning right in to the site. An area of the Te Atatu Road southbound lanes in front of the access will be hatched to minimise interaction between site vehicles and queues on Te Atatu Road, thus providing a gap in southbound vehicle queues for site vehicles to enter the site compound. Such a provision will minimise the effect of site vehicles waiting to turn into the site.

The widening of SH16 eastbound will require the motorway eastbound lanes and shoulders to be narrowed. The re-marking of the motorway and placement of the safety barriers will be staged either side of the Te Atatu Interchange, over a number of nights using **lane closures on SH16**. The prescribed warning signage will be installed in advance of the works and an 80 kph temporary speed limit will be installed over the length of motorway with 3.35m wide lanes (measured from centre line to centre line of pavement markings). The SH16 eastbound widening site will be accessed from Te Atatu Road and the site compound.

The widening of SH16 Westbound, between the Te Atatu Interchange ramps will require the westbound lanes and shoulders to be narrowed. The re-marking of the motorway and placement of the safety barriers will be completed under a night time lane closures. The SH16 Westbound widening site, within the Te Atatu Interchange will be entered from the Te Atatu Interchange Westbound On-Ramp and exited from the westbound off ramp.

The work zones for the widening of the Te Atatu Interchange eastbound off and on ramps will be set up in conjunction with the SH16 widening. The first phase of the eastbound off ramp widening will be completed without affecting the existing alignment. The **inside lane of the eastbound loop on ramp will be closed** to

facilitate the widening. The temporary safety barriers separating the ramps from the construction zone will be installed under night closures.

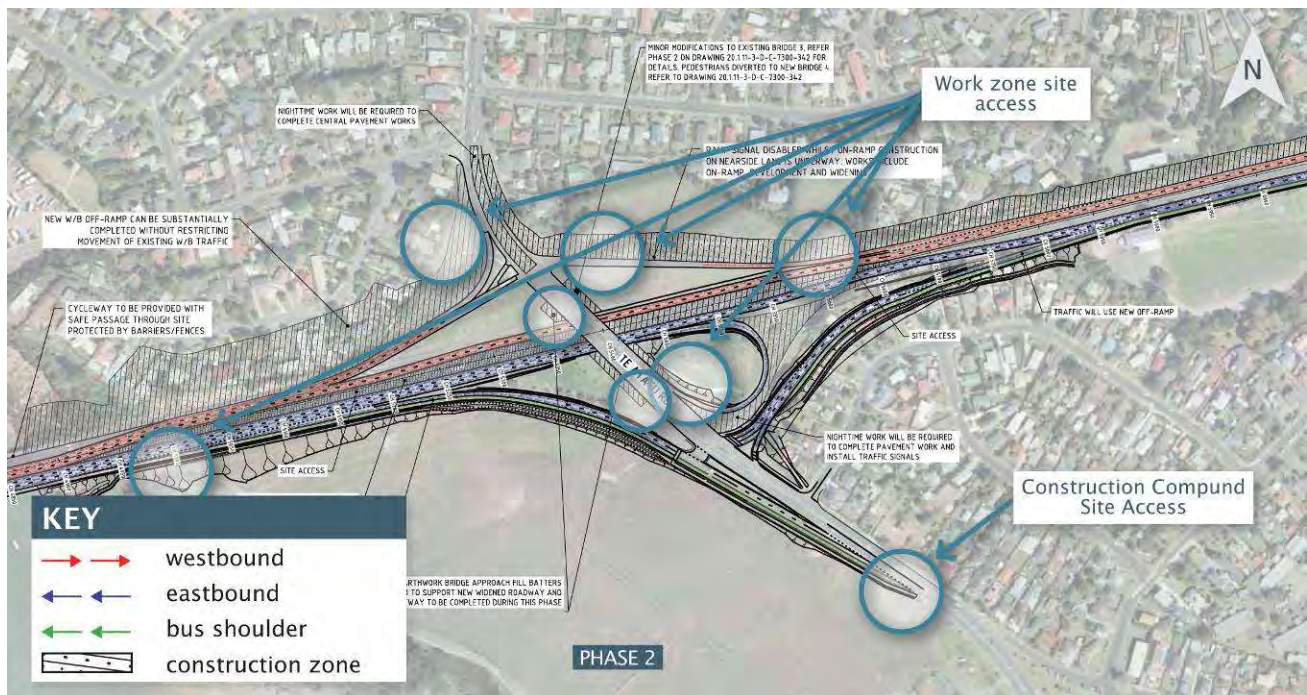
### 7.1.2 Phase 2

A feasible methodology for Phase 2 of the Te Atatu Interchange upgrade might include:

- The widening on the south side of SH16 between Henderson Creek and the Whau River Bridge and the creation of a work zone in the centre of SH16;
- Widening on the southern side of the Te Atatu Interchange Westbound Off-Ramp;
- Widening on the southern side of the Te Atatu Interchange Westbound On-Ramp;
- Shifting the Te Atatu Interchange Eastbound Off-Ramp on to its final alignment;
- Reconstruction of Te Atatu Road, south of the Te Atatu Road bridges;
- Construction of Bridge 4, to the east of Bridge 2 of the Te Atatu Interchange; and
- Reconstruction of Bridge 3, to the west of Bridge 1 of the Te Atatu Interchange.

The traffic management methodology for this phase is indicated in **Figure 7-2** below. The names and locations bridges in the Te Atatu interchange are contained in the Project description.





**Figure 7-2 – Te Atatu Interchange Traffic Management Methodology Phase 2**

The second phase of widening SH16 will shift the SH16 eastbound traffic on to the newly constructed carriageway, which will then be in its final arrangement. The shift will reopen the eastbound shoulder bus lane. The length of SH16 adjacent to the eastbound off ramp will remain aligned to the centre of SH16 to allow for the construction of a retaining wall adjacent to the off ramp. The SH16 Westbound lanes and shoulders will be narrowed.

The re-marking of the motorway and placement of the safety barriers will be staged either side of the Te Atatu Interchange, over a number of nights using lane closures. The new third right hand lane will remain closed until the bridge upgrade and motorway median works are complete. The median work zone will be accessed by site access points at either end of the area in the direction of the motorway flow. A temporary pedestrian / cycle way will be provided through the site, on the south side of SH16 throughout the duration of the works.

The Te Atatu Interchange Eastbound Off-Ramp will be shifted to its final alignment in Phase 2. The off ramp will be closed and detour installed over night to complete the final paving works and line marking on the off ramp and complete construction of the signalised intersection between the eastbound off-ramp and Te Atatu Road. A lane closure will also be installed in the northbound direction on Te Atatu Road to provide a safe working area. The eastbound loop on ramp will be realigned as a single lane to the inside of the loop under a night time closure and detour to relocate barriers and re-mark the pavement markings.

The work zones for the widening of the Te Atatu Interchange Westbound off ramp and on ramp will be set up in conjunction with the SH16 widening. The first stage of the westbound off ramp widening will be completed without affecting the existing alignment. Temporary safety barriers will be installed separating the ramps from the construction zone under night closures. Detours will be installed where a ramp is required to be

closed. The westbound on ramp left hand ramp-meter signal will be disabled while construction on left hand side of the ramp is underway. The site will be accessed from Te Atatu Road.

The lanes in both directions on Te Atatu Road will be closed over night to allow the reconstruction of Te Atatu Road, south of the Te Atatu Road bridges. Shoulder closures and temporary footpaths will be installed during the day to delineate and direct the public around the work zone.

The construction of the new pedestrian / cycle way to the west of Te Atatu Road (Bridge 4) will require the southbound lanes of Te Atatu Road (Bridge 2) to be shifted to the right and narrowed to from 4.0m to 3.1m, and the closure of the adjacent footpath. The new work zone will be accessed by site access points at either end of the closure. Both shoulders will be narrowed to 0.3m and a safety barrier will be installed to separate the construction zone. The re-marking of the southbound lanes and barrier placement will be carried out at night under lane closures. Pedestrians will be diverted on to the footpath adjacent the northbound lanes of Te Atatu Road (Bridge 3) at the signalised crossing points at either end of the bridges.

Once Bridge 4 is complete and has been opened to pedestrians and cyclists, the two southbound lanes on the bridge will be shifted back to the left hand side of Te Atatu Road. A temporary safety barrier will be installed on the right hand side of the southbound lanes. The re-marking of the southbound lanes and barrier placement will be carried out at night under lane closures. Bridge 3 will be closed and cyclists and pedestrians detoured onto the newly constructed Bridge 4 at the signals either end of the Te Atatu bridges.

### 7.1.3 Phase 3

A feasible methodology for Phase 3 of the Te Atatu Interchange upgrade might include:

- The motorway construction in the SH16 median, between Henderson Creek and the Whau River Bridge,
- The opening of the pedestrian / cycle way on southern side of SH16 , westbound shoulder bus lane opened,
- Shifting the Te Atatu Interchange Westbound Off-Ramp on to its final alignment,
- Reconstruction of Te Atatu Road, north of the Te Atatu Road bridges,
- Reconstruction of Bridge 1 on Te Atatu Road

The traffic management methodology for this phase is indicated in **Figure 7-3** below.





**Figure 7-3 - Te Atatu Interchange Traffic Management Methodology Phase 3**

The third phase of widening SH16 will shift the SH16 Westbound traffic on to the newly constructed carriageway, to its final marking arrangement. The shift will open the westbound shoulder bus lane. The length of SH16 adjacent the eastbound off ramp will be realigned to its final arrangement once construction of the retaining wall is complete. A temporary safety barrier will separate the carriageway from the median construction zone. Temporary lighting will be installed behind the barrier to maintain the existing lighting level to the motorway. The re-marking of the motorway and placement of the safety barriers will be staged either side of the Te Atatu Interchange, over a number of nights using lane closures. The new third right hand lane will remain closed until the bridge upgrade and motorway median works are complete. The median work zone will be accessed by site access points at either end of the area in the direction of the motorway flow.

Once the motorway median construction works are complete the final tie in works and safety barrier removal will be completed under lane closures at night.

The new pedestrian / cycle way on the southern side of SH16 will be opened under Phase 3.

The Te Atatu Interchange Westbound Off-Ramp will be shifted onto its final alignment in Phase 3. The off ramp will be closed and detoured via Lincoln Interchange over night to complete the construction of the signalised intersection between the off ramp and Te Atatu Road, and the final paving works and line marking. A lane closure will also be installed in the northbound direction on Te Atatu Road to provide a safe working area.

Lanes in both directions on Te Atatu Road will be closed over night to allow the reconstruction of Te Atatu Road, north of the Te Atatu Road bridges. Access will be maintained to Te Atatu peninsula at all times

however through contra-flow or alternating flow operations. Shoulder closures and temporary footpaths will be installed during the day to delineate and direct the public around the work zone.

The northbound traffic on Te Atatu Road will operate under contra-flow conditions, directing a traffic lane on to both Bridge 1 and Bridge 2 during Phase 3. Temporary lane adjustments will be required at both intersections either end of the Te Atatu Road bridges to safely direct motorists through the contra-flow arrangement. The new work zone will be accessed by site access points at either end of the closure. Temporary safety barriers will be placed and pavement markings altered under lane closures during the night. Full closures of SH16 will be necessary to allow the safe demolition of the remainder of the Bridge 1 bridge deck, and detours will be installed along the off-ramps and back on at the corresponding on-ramp on the other side of the interchange to minimise the effects on road users.

The left hand northbound traffic lane on Bridge 1 will be shifted to the left hand side of Bridge 1, once the first stage of the Bridge 1 reconstruction works are complete. The temporary safety barriers will be placed and pavement markings altered under lane closures during the night.

Once the Bridge 1 reconstruction works are complete, the safety barriers will be removed under lane closures at night. The final surfacing and pavement marking of Te Atatu Road and bridges will be installed under lane closures at night.

## 7.2 Identification and Mitigation of Traffic Effects

Key traffic impacts arising as a result of the Phase 1 works are listed in this section, and appropriate mitigation measures are proposed where possible. Note that the full impacts of the necessary traffic management methodology will not be known until the SSTMP preparation stage, where appropriate mitigation strategies will be developed and agreed with stakeholders and the appropriate road controlling authority.

### 7.2.1 Impacts arising from the temporary work site

This section discusses the impact that temporary work sites on SH16 and Te Atatu Interchange are likely to have on the wider network and the local community.

#### 7.2.1.1 Impacts on Te Atatu Road

Introduction of temporary speed limits and a construction site on Te Atatu Road and on SH16 will result in changes in delays across the interchange. **Table 7.1** below indicates the predicted effect on travel times.

Table 7.1 – Effect of Temporary Work Site on Te Atatu Road Travel Times

Route	AM (minutes:seconds)			PM (minutes:seconds)		
	Base	Scenario	% Change	Base	Scenario	% Change
<b>Te Atatu Road</b> (Harbour View Road to Edmonton Road)	05:08	05:37	9%	04:47	05:17	11%
<b>Te Atatu Road</b> (Edmonton Road to Harbour View Road)	10:14	11:22	11%	04:44	10:53	130%

The highest travel time impact is anticipated to occur on Te Atatu Road northbound along the route from Edmonton Road to Harbour View Road, which is estimated to result in approximately 6 minutes additional travel time in the PM peak. Review of the operational model indicates that the temporary speed limit at the interchange has a significant effect on the operation of the signals, as the existing coordination of the signals is based upon a 50 kph speed limit.

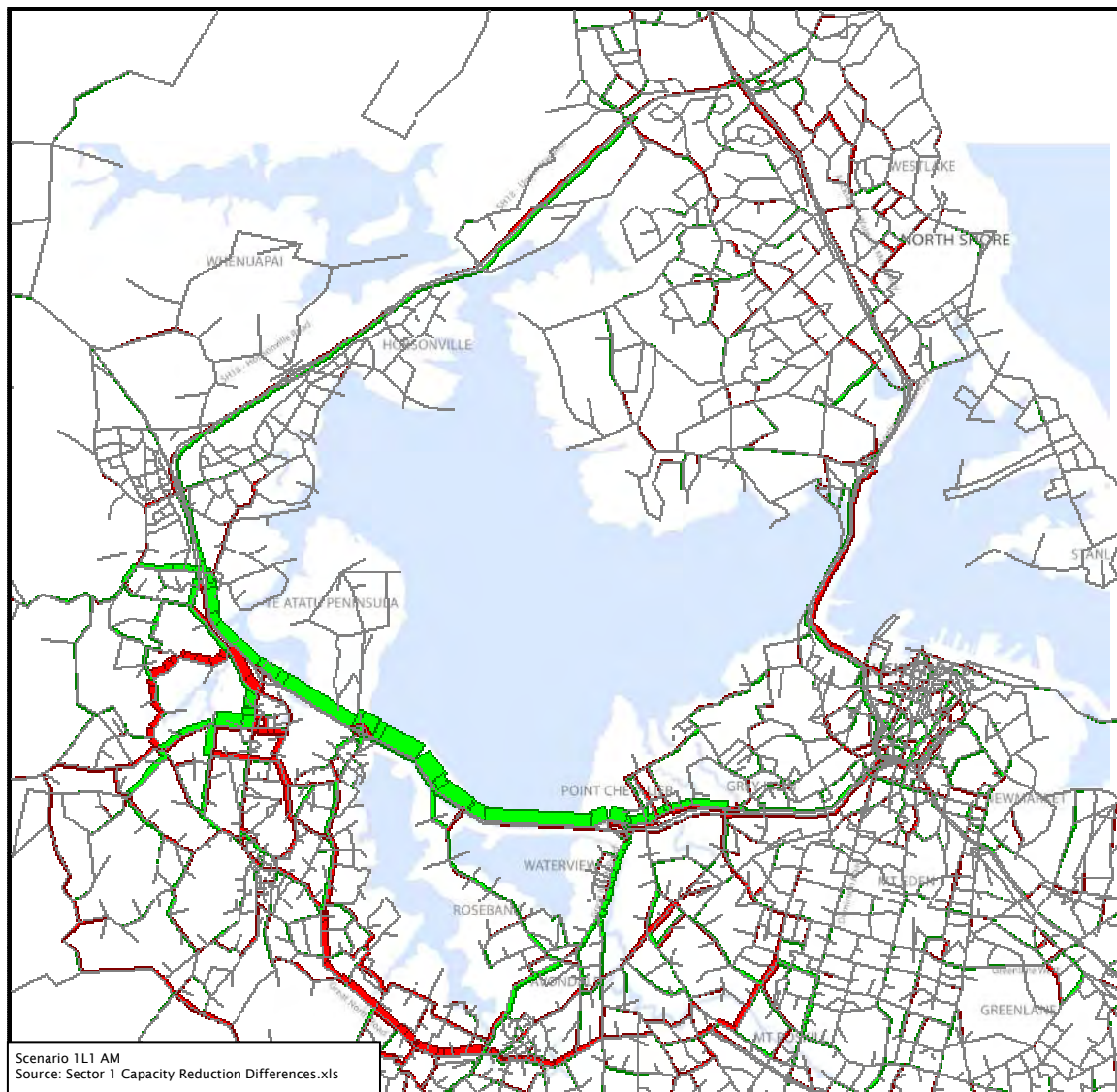
In order to mitigate this impact, the coordination of the signals will need to be reviewed in light of the 30 kph temporary speed limit to optimise capacity through the interchange. It is expected this would reduce the predicted increase on travel times significantly.

In addition to the signal optimisation, extensive communications and road user education may need to be undertaken before works begin on Te Atatu interchange and on SH16 eastbound east of Te Atatu Interchange. This might include incentivising public transport through the site and recommendations of alternative routes that are not as affected.

It is important to note that the changes in travel times noted above are based on a scenario that includes all temporary work sites implemented concurrently along SH16 and Great North Road and therefore the figures quoted above will be a conservative estimate of the effects of the works on the network. As such, it is expected that the travel time effects on Te Atatu Road and other corridors will be able to managed and reduced to less than the COPTTM requirement of inducing no greater than 5 minute delays.

#### 7.2.1.2 Impacts on SH16

**Figure 7-4** below indicates the regional effects possible during the AM peak of a reduction in capacity on SH16 eastbound. **In each of the figures, red denotes an increase in traffic flows, while green denotes a decrease in traffic flows.**

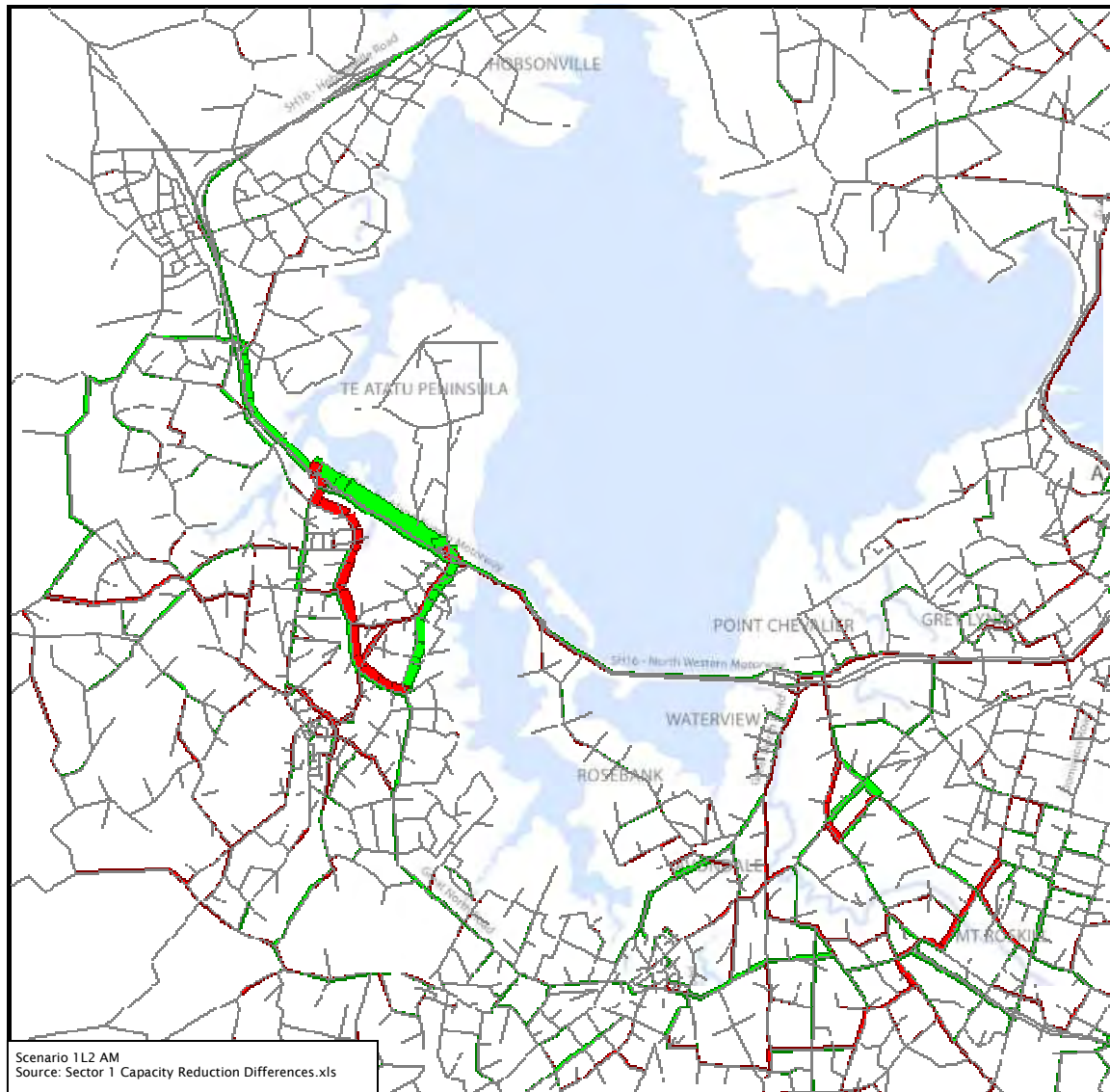


**Figure 7-4 - AM Peak impact of capacity reduction on SH16 Eastbound at Te Atatu Interchange**

This shows that reducing the capacity of SH16 at Te Atatu Interchange is likely to shift traffic onto a number of alternative routes across the region, but Great North Road and SH18 would be particularly affected. In addition, the arterial network feeding Lincoln Road Interchange and Te Atatu Interchange would possibly see a shift in traffic patterns in response to the works.

It is interesting to note that the reduction in capacity may result in a reduction in volumes on Great North Road southbound, south of the Great North Road interchange, which may at that time be subject to lane narrowing and temporary speed limits due to works in Sector 7. This occurs because trips that are provided a marginally faster trip via SH16 will be the first to shift onto the alternative routes, which are expected to be Great North Road and West Coast Road.

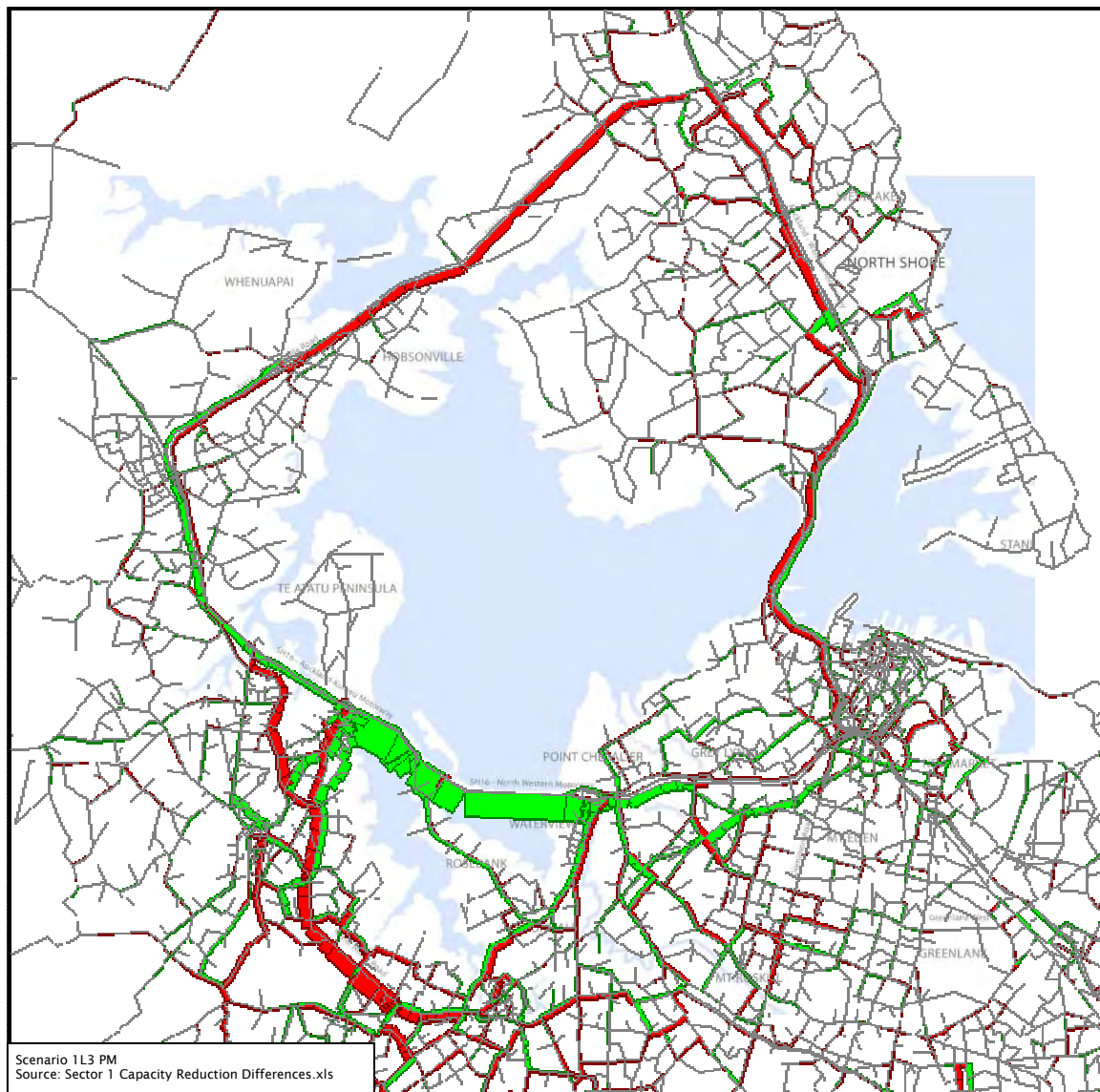
Figure 7-5 below shows the impacts of a capacity reduction on SH16 Eastbound west of Te Atatu Interchange.



**Figure 7-5 – AM Peak Impact of capacity reduction on SH16 Eastbound west of Te Atatu Interchange**

This shows that the impacts of activities to the west of the Te Atatu Interchange would experience more localised impacts than those within the interchange. This is because there exists a feasible alternative route via Central Park Drive, which is not readily available for the section immediately to the east of this location.

Figure 7-6 below shows the impacts of a capacity reduction on SH16 Westbound east of Te Atatu Interchange.



**Figure 7-6 – Impacts of capacity reduction on SH16 Westbound east of the Te Atatu Interchange**

This indicates that SH16 Westbound at Te Atatu Interchange is sensitive to changes in capacity, and that a reduction in capacity could affect Great North Road and alternative routes through New Lynn if capacity is affected in this area. The model also predicts a number of trips using the Auckland Harbour Bridge (AHB) and SH18 as an alternative to SH16 in this scenario, however the actual magnitude of these diversions is difficult to predict given the sensitivity of the motorway environment to a variety of factors (as noted previously in section 5).

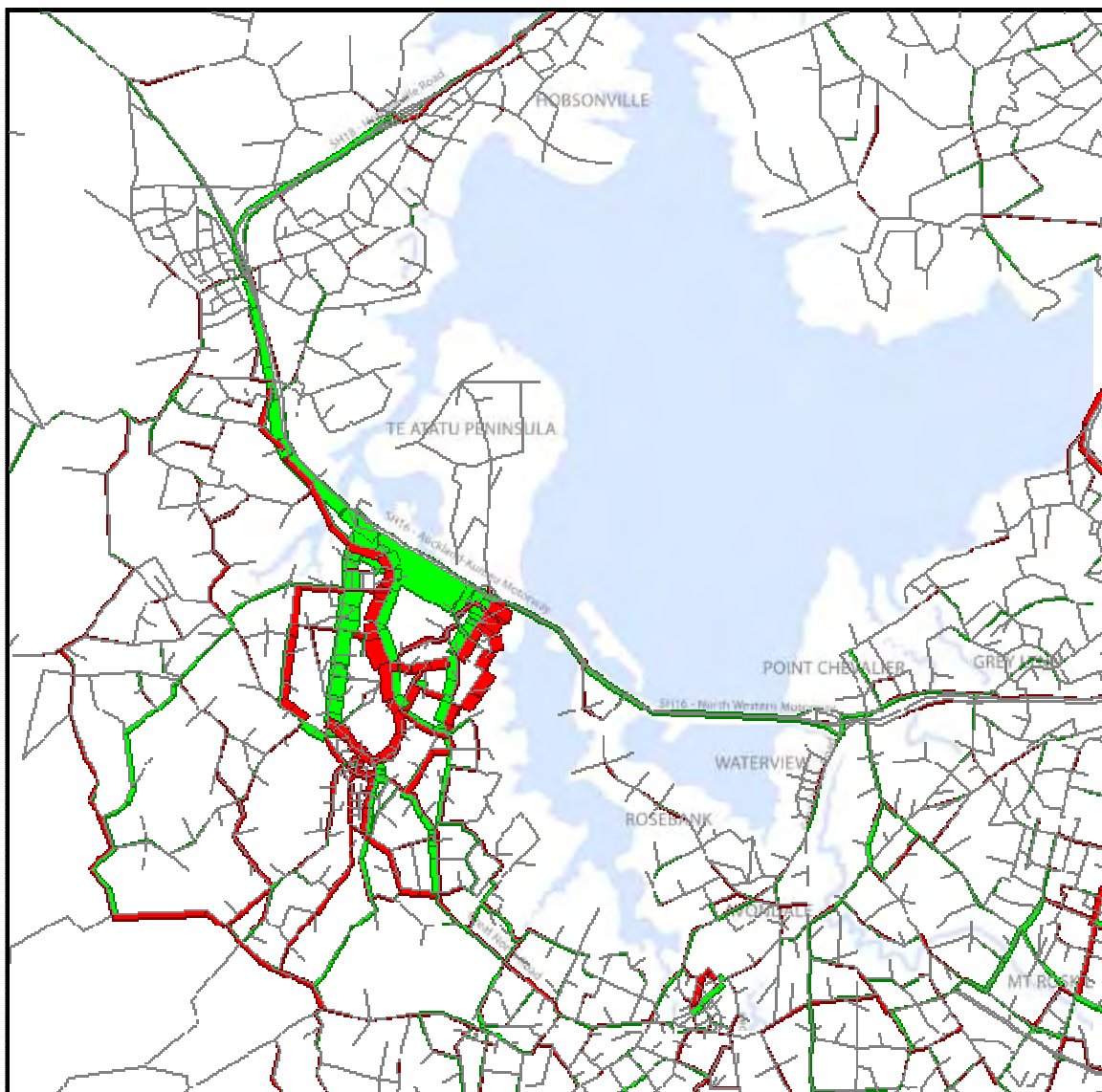
At present, it is thought that the capacity on SH16 Westbound is primarily governed by capacity on the arterial network and at the off-ramp terminus. As such, these predictions are expected to be 'worst case' scenarios.



In reality, it is likely that small reductions in motorway capacity would simply generate increased queues as opposed to large shifts in traffic patterns predicted by the model.

However, identification of these impacts is important as it will inform the mitigation strategies developed for implementation upon commencement of works on site and inform monitoring requirements for network performance during construction.

**Figure 7-7** below shows the impacts of a capacity reduction on SH16 Westbound east of Te Atatu Interchange.



**Figure 7-7 – Impacts of capacity reduction on SH16 Westbound west of the Te Atatu Interchange**

Similarly to the equivalent capacity reduction scenario on SH16 Eastbound between Lincoln and Te Atatu Interchanges, this scenario shows that impacts of capacity reduction to the west of Te Atatu Interchange are likely to be more localised than those further to the east. This is due to the more readily available diversion routes via Central Park Road and Te Atatu Road.

## 7.2.2 Impacts arising from temporary closures

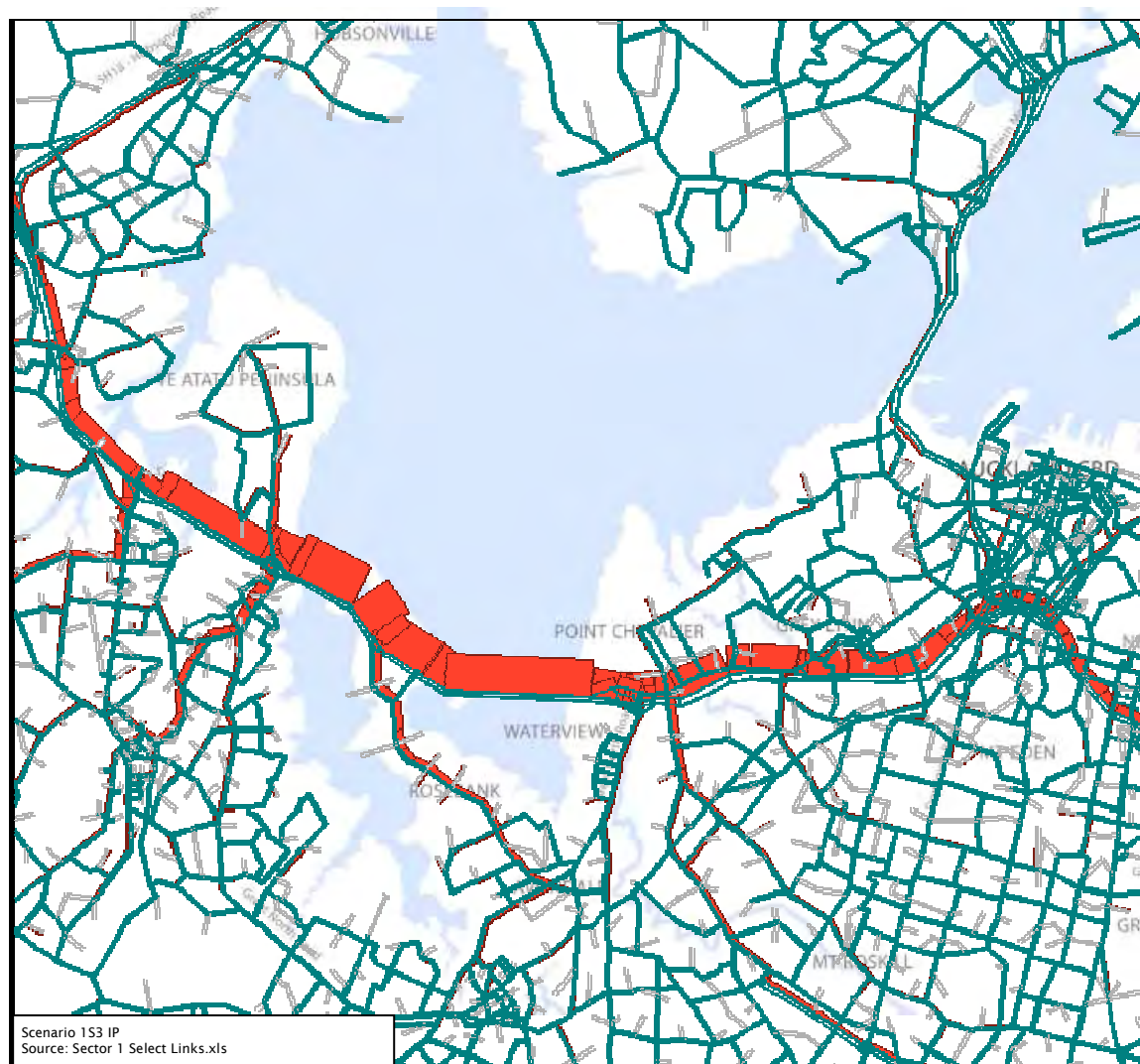
### 7.2.2.1 Existing situation

This section provides an overview of the night time traffic flows that are predicted to pass through Sector 1 during construction, and are therefore likely to be impacted by the works as a result of lane, ramp and mainline carriageway closures.

The figures in each of the sections titled 'Impacts arising from temporary closures' from this point in the assessment are 'select link' analyses from the Project Assignment Model. Select links provides an indication of the origins and destinations of trips passing through a chosen link on the network. As such, the figures do not provide an indication of the scale of impacts arising from the closure – instead they help identify the pattern of trips that will be affected by the closures necessary to facilitate the works. This provides an insight into the affected trips, but also into how to best communicate with road users in mitigating the effect of the closure.

**Figure 7-8** below indicates the pattern of all SH16 Eastbound trips through the Te Atatu Interchange that will likely be affected by the works at one time or another. It is not expected that all of this traffic will be impacted concurrently, however this provides an indication of the typical pattern of trips passing through Sector 1.





**Figure 7-8 – SH16 Eastbound East of Te Atatu Interchange Traffic Pattern**

This figure shows that the majority of trips passing through Te Atatu interchange originate from Westgate, Te Atatu Road northbound and Lincoln Road, which is as expected. Road user education campaigns shall therefore focus on informing road users on those routes in that order of priority through the use of VMS and Project signage. Road user education shall include pre-conditioning in the week prior to closures on SH16 and warning during the closure, which will provide road users with the opportunity to make alternative trip choices thereby minimising delays and inconvenience arising from the closures.

**Figure 7-9** and **Figure 7-10** show the traffic patterns on the two SH16 Eastbound Te Atatu Road On-Ramps.

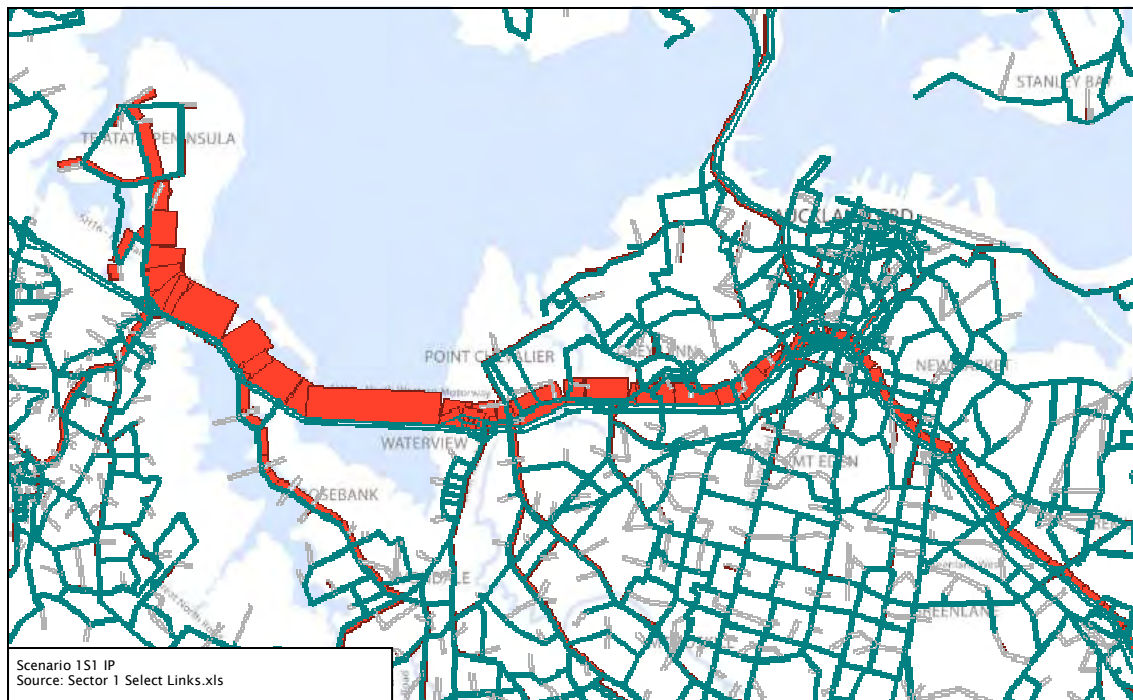


Figure 7-9 - SH16 Eastbound Te Atatu On-Ramp Traffic Pattern

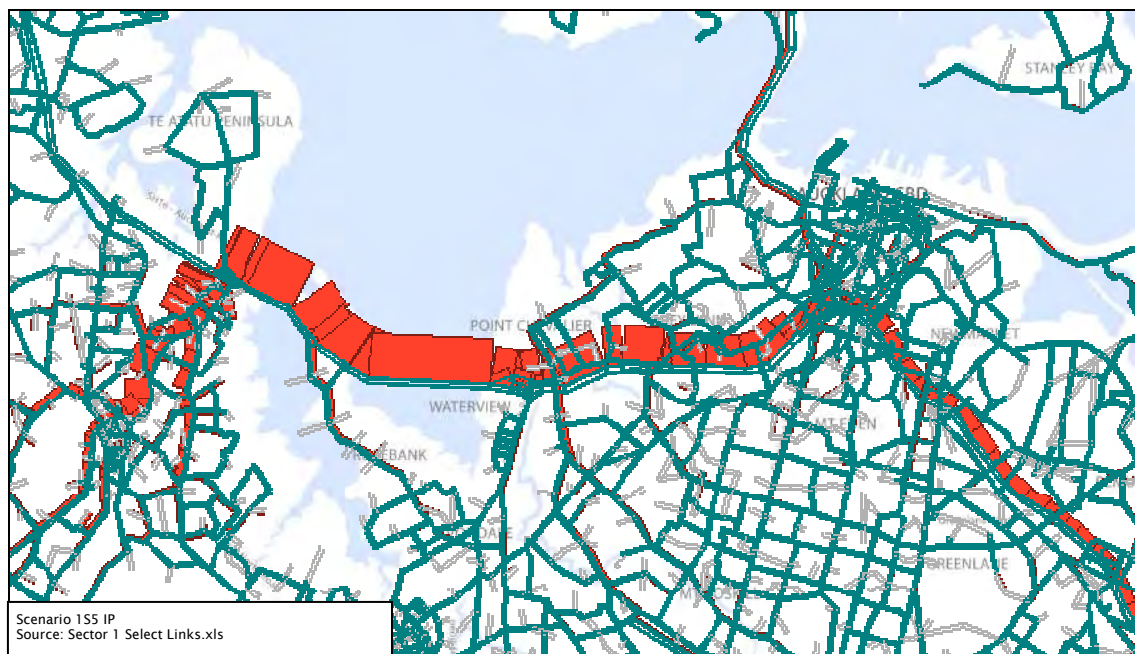


Figure 7-10 - SH16 Eastbound Te Atatu Loop On-Ramp Traffic Pattern

This shows that it will be relatively simple to communicate with drivers entering the eastbound Te Atatu On-Ramp, while communications for the Te Atatu Loop On-Ramp may need more careful planning to capture the full range of trips that enter from a range of locations across Henderson and Waitakere. It is recommended that use of VMS or Project signage should focus on pre-conditioning at the loop on-ramp itself or immediately to the east of the merge with SH16.

The construction works at the Te Atatu Interchange will require a number of closures of SH16 and the five ramps throughout construction. Motorists will be advised of off ramp closures at the previous interchange in advance and during off ramp closures. Traffic will be directed down the following detour routes when each road is closed.

Access to Te Atatu peninsula will be maintained throughout the works. Road access to the peninsula is only achieved via Te Atatu Road through the interchange with SH16, and as such it is not considered acceptable to cut off access to the peninsula for any period during the works. Access to the peninsula must be maintained continuously for emergency services, and as such it will be necessary to maintain a trafficable corridor past any work site or closure.

#### 7.2.2.2 SH16 through Te Atatu Interchange

It is anticipated that closures will be necessary on SH16 through the Te Atatu Interchange to facilitate construction and demolition works on the Te Atatu Interchange bridges.

During the closure of SH16, traffic will be directed off at the Te Atatu off ramps and through to the on-ramps. The signals at the top of the westbound ramps will be optimised to allow the traffic to continue to flow efficiently across Te Atatu Road and minimise delay for the diverted motorway traffic. Timing of the closure will take into account traffic demands on Te Atatu Road so that an acceptable level of service is achieved throughout the closure.

Modifications to the signal timing and operation at the eastern end of the eastbound off-ramp will be necessary during the closure, and manual traffic control on the Te Atatu Road approaches may be necessary to achieve safe operation of the intersection during the closure.

#### 7.2.2.3 SH16 east of Te Atatu Interchange

At this time, it is not expected that full closures will be necessary on SH16 east of the Te Atatu Interchange. This is because there are three lanes available and therefore it is anticipated that any activity requiring closures would be able to be facilitated under two-lane closures.

This is fortunate, considering the length of the detour route that would be necessary for closing either the east or westbound direction, which is shown in **Figure 7-11** below.



**Figure 7-11 – SH16 Eastbound East of Te Atatu Interchange Detour**

#### 7.2.2.4 Westbound Te Atatu Interchange Off-Ramp

Closures of the westbound Te Atatu Interchange Off-Ramp will be necessary for pavement works, road re-marking and realignment and other works on the shoulder of the off-ramp.

During closure of the off-ramp, traffic will be directed to exit SH16 at the Lincoln Interchange where it will u-turn at the interchange and re-enter at the Lincoln Interchange Eastbound On-Ramp, as shown in **Figure 7-12** below.





**Figure 7-12 - Te Atatu Interchange Westbound Off-Ramp Detour**

#### 7.2.2.5 Westbound Te Atatu Interchange On-Ramp

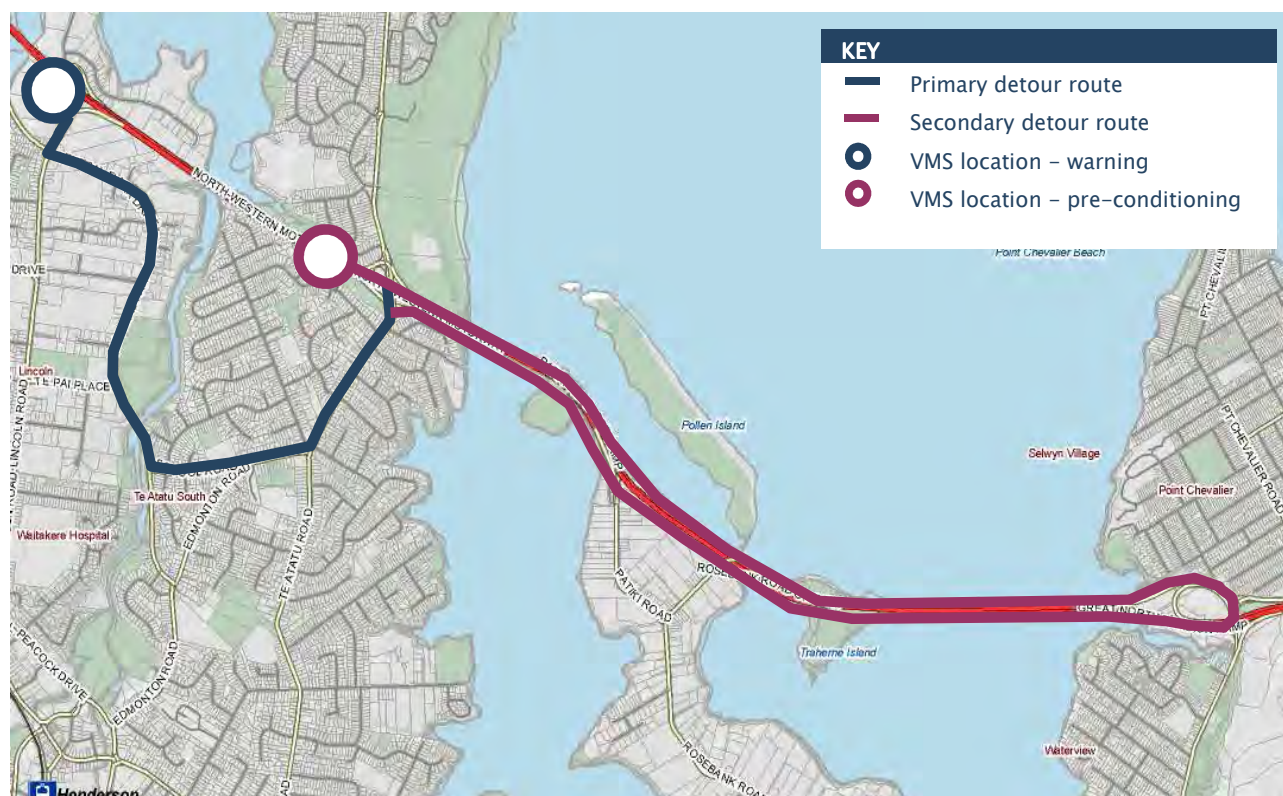
Closures of the westbound Te Atatu Interchange On-Ramp will be necessary for pavement works, road re-marking and realignment and other works on the shoulder of the off-ramp.

On-ramp traffic will be directed to the SH16 on ramp at the Lincoln Interchange. Traffic will be directed to the Lincoln Interchange via Te Atatu Road, School Road and Central Park Drive. Traffic which approaches the Te Atatu Interchange from the south will be redirected to head south down Te Atatu Road via Titoki Street and Toru Street.

### 7.2.2.6 Eastbound Te Atatu Interchange Off-Ramp

Due to the distance between Te Atatu Interchange and the next available interchange, two detour routes will be considered for the eastbound Te Atatu Interchange Off-Ramp.

A recommended detour route will be communicated west of the Lincoln Road Off-Ramp, directing traffic via Central Park Drive and School Road. Traffic that misses the recommended alternative route will be directed down the motorway to exit SH16 at the Waterview Interchange and directed back onto SH16, though to the Te Atatu Interchange Westbound Off-Ramp. This scheme is shown in **Figure 7-13** below.



**Figure 7-13 - Te Atatu Interchange Eastbound Off-Ramp Detour Routes**

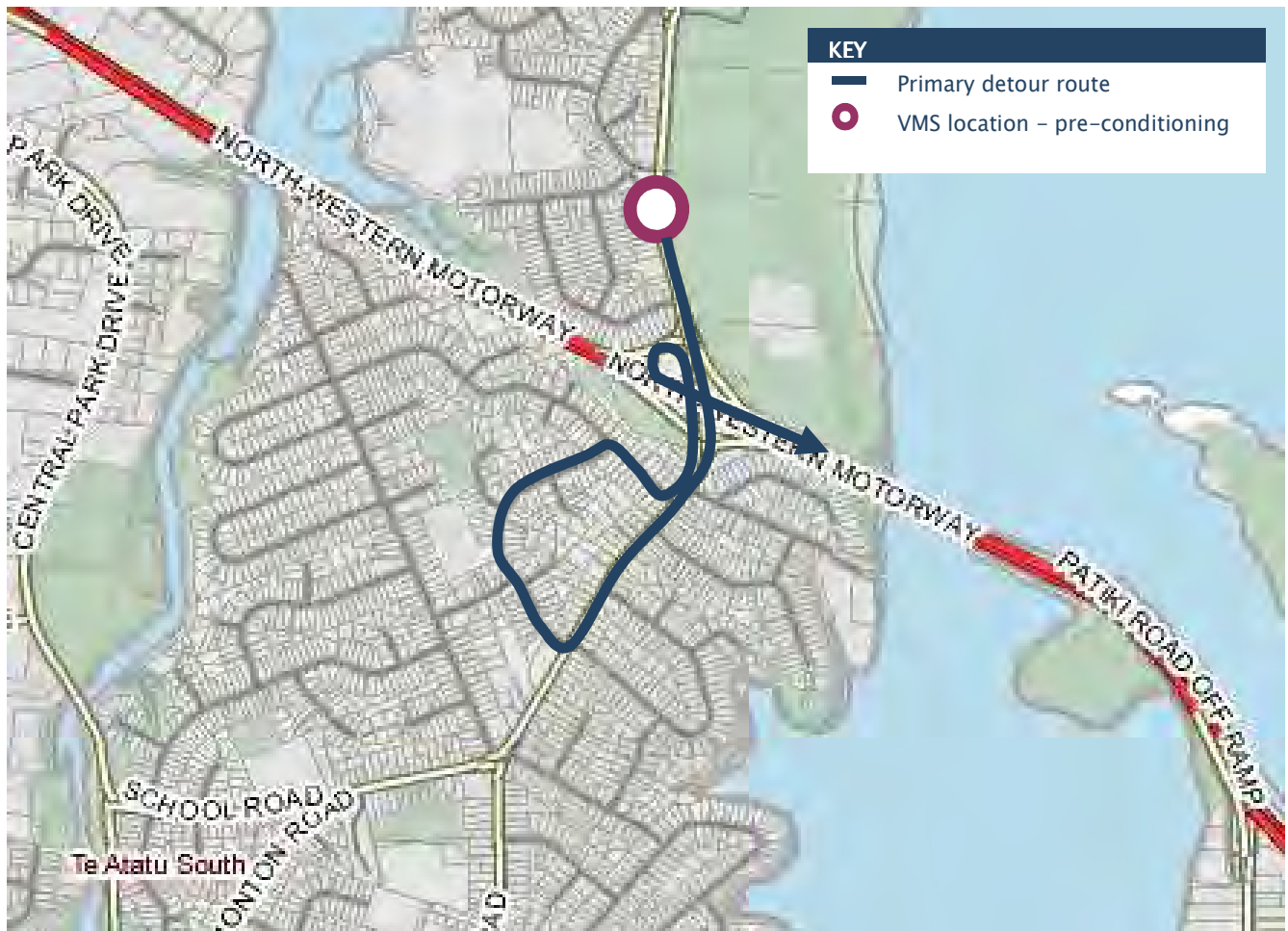
### 7.2.2.7 Te Atatu Interchange Eastbound Loop On-Ramp

The Te Atatu Interchange Eastbound On-Ramp traffic will be directed to the eastern Te Atatu Interchange On-Ramp. The on ramp traffic will be permitted to turn right onto the Te Atatu Interchange Eastbound On-Ramp via the existing HOV and bus lane.

Due to the very short detour route required for this closure, minimal effects are expected provided the closure is timed to avoid peak periods.

### 7.2.2.8 Te Atatu Interchange Eastbound On-Ramp

The on ramp traffic will be directed to the Te Atatu Interchange Loop On-Ramp. The on ramp traffic will be redirected to head north down Te Atatu Road via Vera Road and Royal View Road.



**Figure 7-14 - Te Atatu Interchange Eastbound On-Ramp Detour**

Due to the lack of alternative routes and sensitive nature of the roads on the detour route for this closure, VMS preconditioning will be required in advance of the works, and the closure will be timed so that the impacts on the local road network are minimised where possible.

### 7.2.3 Impacts on pedestrians and cyclists

During the reconstruction of the Te Atatu Bridge over SH16, pedestrians crossing the bridge will be detoured to either side of the bridge at the signalised intersection on the southern side of the interchange and at a temporary pedestrian refuge that will be installed to the north of the interchange.

#### 7.2.4 Impacts arising from site access

Site access movements will affect traffic capacity and safety on Te Atatu Road, and as such there will be restrictions placed on the management of the site access, which may include:

- Restriction of the types of vehicles that are permitted to use the access during the AM peak from 7am – 9am;
- Installation of right turning bay on Te Atatu Road; and
- Installation of hatching at entry on Te Atatu Road to minimise southbound traffic queue effects on right turns to the site.

The Te Atatu construction compound site (construction yard no. 1) access will be located off Te Atatu Road, north of the interchange. The location of the construction compound site access is shown on the phase diagrams in section 3.1 above. A right turn bay will be marked on the Te Atatu Road median for vehicles turning right in to the site. An area of the Te Atatu Road southbound lanes in front of the access will be hatched to minimise queue interaction.

The location of the site access points, for each work zone, for each construction phase is shown on the figures included in section 3.1 above. The site access points for each work zone will be positioned on the local road network where possible. Site access points on SH16 will not be in operation during peak hour times. Where acceleration and deceleration lanes cannot be provided for site access points on SH16, temporary lane closures will be installed outside of peak hour traffic periods to provide acceleration and deceleration lengths. The site access points on the local network will be designed in accordance with RCA requirements and consider turning bays for vehicles entering the access and appropriate visibility.

#### 7.2.5 Impacts on public transport

It is expected there will be some effects on the operation and performance of buses during works on Sector 1. The effect on buses will be mitigated where possible through:

- Reinstatement of bus lanes and / or priority as rapidly as possible as works allow;
- Liaising with passenger transport authorities and operators throughout the works to arrange alternative or mitigating measures for buses through the work site; and
- Providing alternative means of priority where possible, which may include supplementing the Te Atatu Interchange signals and off / on ramp HOV provisions if feasible.



## 8. Sector 2 - Whau River

### 8.1 Preliminary Traffic Management Methodology

The widening of the Whau River Bridge is planned to be constructed under five phases of **mainline realignments with associated lane and shoulder narrowing**. Each phase is expected to realign SH16 by re-marking lanes and installing safety barriers to open up work zones to allow off-line construction. The left hand shoulder/ bus lane will be closed during some phases to maximise the work zones, however a temporary pedestrian / cycle way will be maintained.

In the first and second phases, it is currently expected the eastbound bridge deck will be extended and then joined to the existing bridge. The westbound bridge deck widening will be undertaken in phase three with central median works undertaken in phase four and final surfacing under phase five. During the works, lanes on SH16 will generally be narrowed to a minimum of 3.35m and shoulders to a minimum of 0.3m, 0.5m where possible. Where shoulder narrowing is implemented, opportunities for providing emergency stopping bays for incidents, breakdowns and emergency services will be investigated and implemented where they can be facilitated by the work site.

Bus shoulders on SH16 will be provided from the fourth phase as construction works allow.

The existing number of lanes on the mainline and on the ramps will remain operational throughout works. There will be two instances, during Phase 2 and 3 (respectively) where the eastbound and westbound carriageways will be divided into two separate carriageways with one lane in a 'bull-run' arrangement.

The bull-run construction methodology has been developed in order to complete the works within the existing designation and to maintain the existing number of lanes across the Whau River Bridge throughout works. The bull-run would be in operation continuously throughout the stage where it is noted – i.e. 24 hours per day until the stage is complete. Without a significant temporary realignment of SH16 and therefore potential impacts on property to the south of the alignment or Te Atatu Interchange, it is necessary to implement the bull-run to retain the existing three lanes in both instances.

The design of the bull-run cannot yet be developed to a level of detail sufficient to understand the interrelation between the temporary layout and the interchanges on either side of the Whau River Bridge. This is because the possible geometric alignments are sensitive to the staging of works on the reclamation to the east and the interchange works to the west. As such, the only current certainty is that the number of existing lanes can be provided at the cross section of the Whau River Bridge. While it is acknowledged that these interface issues with the adjacent sectors may result in increased traffic impacts, it is expected this will be acceptably managed in accordance with the CTMP.

For example, during Phase 2 it is not yet known whether it will be possible to cater for both the eastbound on-ramps, or whether the western eastbound on-ramp could merge with SH16 Eastbound prior to the bull-run. The project assignment model indicates that the two Te Atatu Interchange on-ramps have demands of 1,100 vph (eastern ramp) and 1,490 (western loop ramp) in the AM peak, while through traffic from east of Te Atatu Interchange has a demand of approximately 3,200 vph. With these demands, it is necessary for lane utilisation that the western loop on-ramp is permitted to access both the bull-run and the other two mainline lanes over Whau River Bridge to balance flows on SH16. This will be considered in design and operation of the bull-run and in operation of the ramp signals on the two on-ramps.

The works on the Whau River Bridge will be staged from the construction yard no. 1 accessed from Te Atatu Road, north of SH16.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary for site access from the motorway.

**Figure 8-1** below indicates the scope of work on the Whau River Bridge.

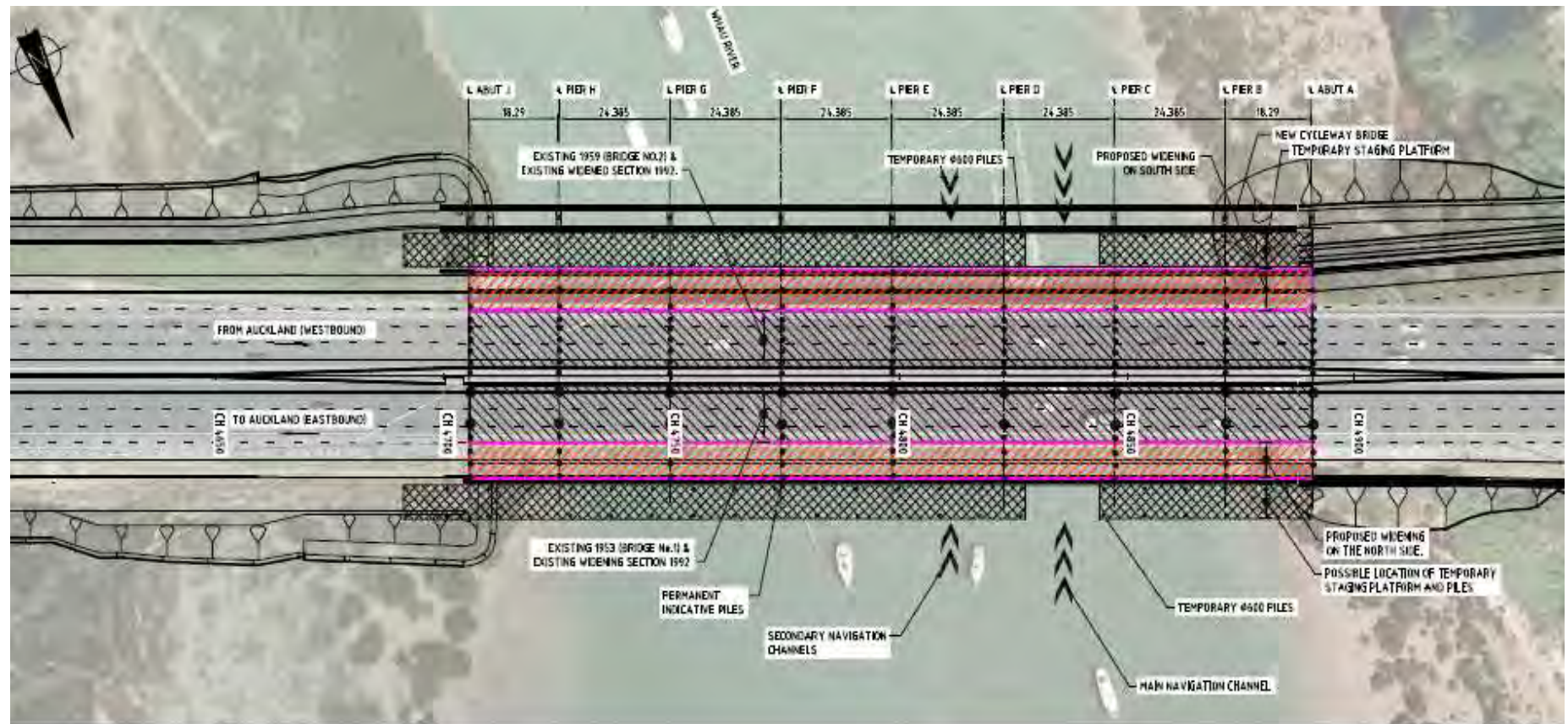


Figure 8-1 - Whau River Bridge Construction Activities

### 8.1.1 Phase 1

The widening of the Whau River Bridge will initially require the eastbound lanes and shoulders to be narrowed. A temporary safety barrier will separate the carriageway from the construction zone. The re-marking of the motorway and placement of the safety barriers will be installed over night using lane closures. The prescribed warning signage will be installed in advance of the works and an 80 kph Temporary Speed Limit installed over the length of motorway with 3.35m wide lanes.

The widening of SH16 Eastbound, east of the Whau River Bridge will require the eastbound lanes and shoulders to be narrowed. A temporary safety barrier will separate the carriageway from the construction zone. Temporary lighting will be installed behind the barrier to maintain the existing lighting level to the motorway. The re-marking of the motorway and placement of the safety barriers will be staged either side of the Te Atatu Interchange, over a number of nights using lane closures. The SH16 Eastbound widening site will be accessed from SH16.

### 8.1.2 Phase 2

During the second phase of the Whau River Bridge widening, the left hand eastbound lane will be repositioned to the north side of the newly constructed bridge deck to form a 'bull-run' arrangement. The left hand eastbound lane and shoulders will be narrowed and only carry the traffic from both the Te Atatu Interchange Eastbound On-Ramps. This will be achieved by installation of temporary barriers and / or a continuous white line with safe-hit posts between the on-ramp alignment and the remaining two lanes on SH16 Eastbound. The re-marking of the motorway and placement of the safety barriers will be installed over night using lane closures.

The new pedestrian / cycle way bridge on the southern side of the Whau River Bridge will commence without affecting the motorway traffic.

### 8.1.3 Phase 3

Under Phase 3, the eastbound lanes will be re-marked on the northern side of the Whau River Bridge. The westbound traffic will be directed in to a contra-flow arrangement. Two lanes will be set out on the northern bridge and one on the southern bridge which will only carry the Te Atatu Interchange Eastbound Off-Ramp traffic. Cyclists will be diverted onto a temporary pedestrian / cycle way adjacent to SH16. The re-marking of the motorway and placement of the safety barriers will be installed over night using lane closures.

### 8.1.4 Phase 4

Under Phase 4, the lanes and shoulders will be re-marked to shift the lanes in both directions away from the centreline of the Whau River Bridge and reopen the bus shoulders in both directions. The shift will create a

work zone in the centre of the bridge. The re-marking of the motorway and placement of the safety barriers will be installed over night using lane closures.

The temporary cycle lane will be diverted on to the new cycle bridge during Phase 4.

### 8.1.5 Phase 5

Once the bridge modification works are complete, the safety barriers will be removed under lane closures at night. The final surfacing and pavement marking of the bridge will be installed under lane closures at night.

## 8.2 Identification and Mitigation of Traffic Effects

The effects arising from construction activities on the Whau River Bridge are broadly similar to those that can be anticipated to occur in Sector 4 with lane closures, lane narrowing and other traffic management activities common to both sectors. For details of the effects and their mitigation refer to **section 10.4** below.

### 8.2.1 Impacts arising from the temporary work site

Impacts arising from the temporary work site required for works in Sector 2 are covered by the discussion of the TTM methodology necessary for Sector 1 works in **section 7.2.1** above.

### 8.2.2 Impacts arising from temporary closures

Temporary closures required for works in Sector 2 are covered by the discussion of the closures necessary for Sector 1 works in **section 7.2.2** above.

### 8.2.3 Impacts arising from site access

The Whau River construction compound site access will be located off Patiki Road, which runs parallel with the SH16 Westbound Patiki On-Ramp. A defined entry and exit point to the site will be implemented on the site frontage to Patiki Road.

The work zones will be accessed either off Patiki Road or off SH16. The site access points, for each work zone accessed off SH16 will be positioned at either end of the work zones, accessed in the direction of the adjacent SH16 traffic flow. Site access points on SH16 will not be in operation during peak hour times. Where acceleration and deceleration lanes cannot be provided for site access points on SH16, temporary lane closures will be installed outside of peak hour traffic periods to provide acceleration and deceleration lengths.

## 9. Sector 3 - Rosebank Terrestrial

Rosebank terrestrial is expected to be undertaken largely off-line and under the traffic management methodology described in section 10 below.

The work site in Sector 3 will typically be accessed from Patiki Road or SH16. Access for cyclists and pedestrians along the existing pedestrian / cycle way, and access to Rosebank Domain will be maintained throughout works.

For identification and mitigation of traffic effects arising from Sector 3 activities, please refer to section 10 below.

## 10. Sector 4 – Reclamation

### 10.1 Preliminary Traffic Management Methodology

The widening of the SH16 causeway is planned to be constructed under four temporary phases. Each phase is expected to realign SH16 by re-marking lanes and installing safety barriers to open up work zones to allow off-line construction. The left hand shoulder/ bus lane will be closed during some phases to maximise the work zones, however a temporary pedestrian / cycle way will be maintained.

The existing number of lanes on the mainline and on the ramps will remain operational throughout works, and the carriageway narrowed to a minimum of 3.35m lanes and shoulders to a minimum of 0.3m, and 0.5m where possible. Where shoulder narrowing is implemented, opportunities for providing emergency stopping bays for incidents, breakdowns and emergency services will be investigated and implemented where they can be facilitated by the work site.

In summary, the construction methodology employed in Sector 4 commences on the northern side of SH16 to widen the existing shoulder and complete works on the causeway reclamation. This is followed by similar works to the south of SH16, which allows completion of works in the median through utilisation of the newly constructed shoulders.

The existing bus shoulders on SH16 eastbound will be removed during the first two stages. During phase three the eastbound bus shoulder will be open from the Whau River Bridge to the Rosebank Bridge (not past the Rosebank On-Ramp) and westbound open from the Great North Road Interchange to the Rosebank Off-Ramp. During phase four the eastbound bus shoulder will remain open from Whau River Bridge to Great North Road Interchange (but not past the Rosebank On-Ramp as existing) and westbound bus shoulder from Great North Road Interchange to the Rosebank Off-Ramp.

The Rosebank Bridge widening will take place in line with the causeway widening and following the same staging. The SH16 Eastbound traffic over the bridge will operate under a contra-flow arrangement during stage three.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary for site access from the motorway. The re-marking of the motorway and placement of barriers for each phase will be carried out at night, under lane closures. The Rosebank Road on and off ramps and the Patiki Road on and off ramps will closed over night to rearrange the markings and install barriers for each phase.

The works will be staged from the construction yard no. 1 accessed from either Te Atatu Road (north of SH16) or SH16 Eastbound. Site accesses to the compound will be designed and managed to minimise the effect on

the road network, which will be agreed with the RCA and / or the NZTA's network maintenance consultant in a SSTMP prior to start of works.

Truck movements to / from SH16 will be prohibited during peak periods (06:00 – 0:900 on SH16 eastbound and 15:00 – 18:00 on SH16 westbound), and will require escorted exit/entry at other times, the requirements of which will be agreed with the RCA in advance of works commencing on site.

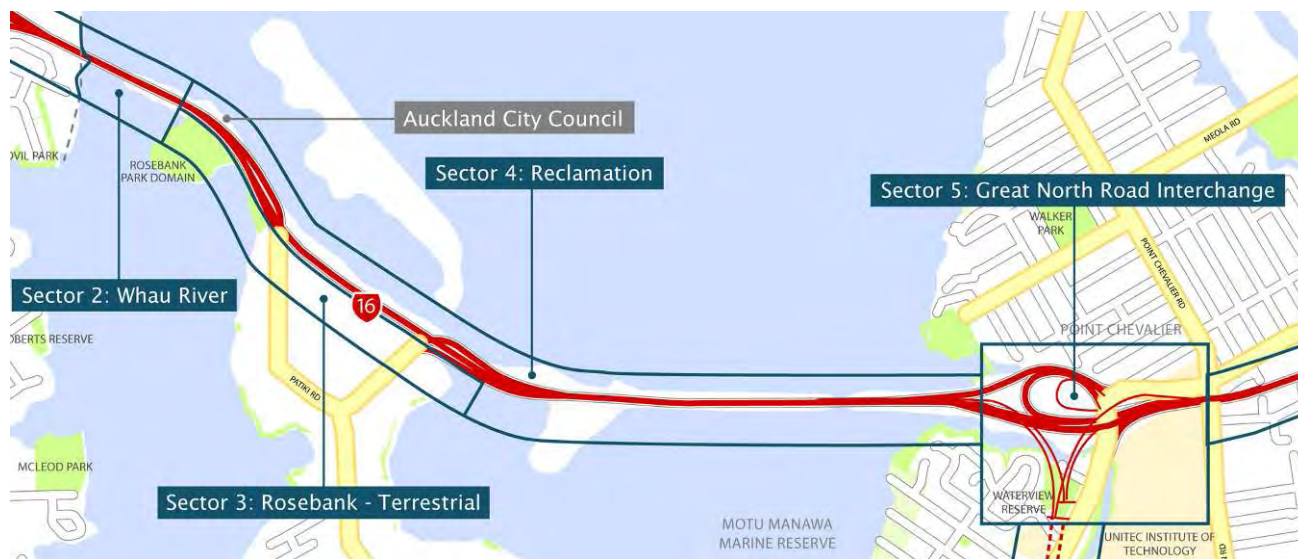


Figure 10-1 – Extent of Sector 4

## 10.2 Phase 1

Phase 1 works in Sector 4 are broadly to the north of SH16, with SH16 eastbound shifted to the median (to the right) to provide working space. The work zone extends partly along Patiki Off-Ramp, and the off-ramp will be narrowed and a minor realignment installed to facilitate works in the gore area (between the mainline carriageway and the off-ramp).

Bus shoulders will be removed throughout the length of the narrowed lanes on SH16 Eastbound during this phase of works.

Site access will be provided from the SH16 carriageway where works occur, and it is expected that at least two site accesses will be operational throughout the works. Site accesses will be located to best facilitate works, however sight distances will be considered by NZTA's appointed contractor and in accordance with the CTMP in determining the location.



### 10.3 Phase 2

This phase only relates to a minor realignment of SH16 eastbound in the vicinity of the Whau River Bridge (Sector 3) where the left hand lane is separated onto the newly constructed bridge segment (bull-run) and does not constitute a significant separate phase of work for the remainder of the SH16 reclamation works.

### 10.4 Phase 3

Phase 3 works in Sector 4 are broadly to the south of SH16, with SH16 Westbound shifted to the median (to the right) to provide working space. The work zone extends partly along Patiki On-Ramp, and the off-ramp will be narrowed and a minor realignment installed to facilitate works in the gore area (between the mainline carriageway and the on-ramp).

Bus shoulders will be reinstated on SH16 Eastbound east from Patiki Road Off-Ramp during this phase of works.

Site access will be achieved from the road that connects to Rosebank Park Domain, along which a construction yard will be established. Where necessary site access may be provided from SH16, however as noted previously, site accesses will be located to best facilitate works, however sight distances will be considered in determining the location.

### 10.5 Phase 4

Phase 4 involves work in the median as permitted by the Phase 1 and Phase 3 works on the outside shoulders of SH16.

The westbound bus lane on SH16 will be re-opened from Patiki On-Ramp to Te Atatu Interchange, while the eastbound bus lane will be extended from Te Atatu Interchange to Patiki Off-Ramp. The eastbound bus lane to the east of Patiki Off-Ramp remains open.

Site access will be provided from the SH16 carriageway where works occur, and it is expected that at least two site accesses will be operational throughout the works. Due to the work site being situated in the median, site accesses will enter the fast lane of SH16 on either side. Where possible, deceleration and acceleration lanes will be provided at the site accesses, and escorted entry / exit will be necessary for trucks and larger vehicles. Peak period restrictions will apply with eastbound AM peak restrictions and westbound PM peak restrictions.

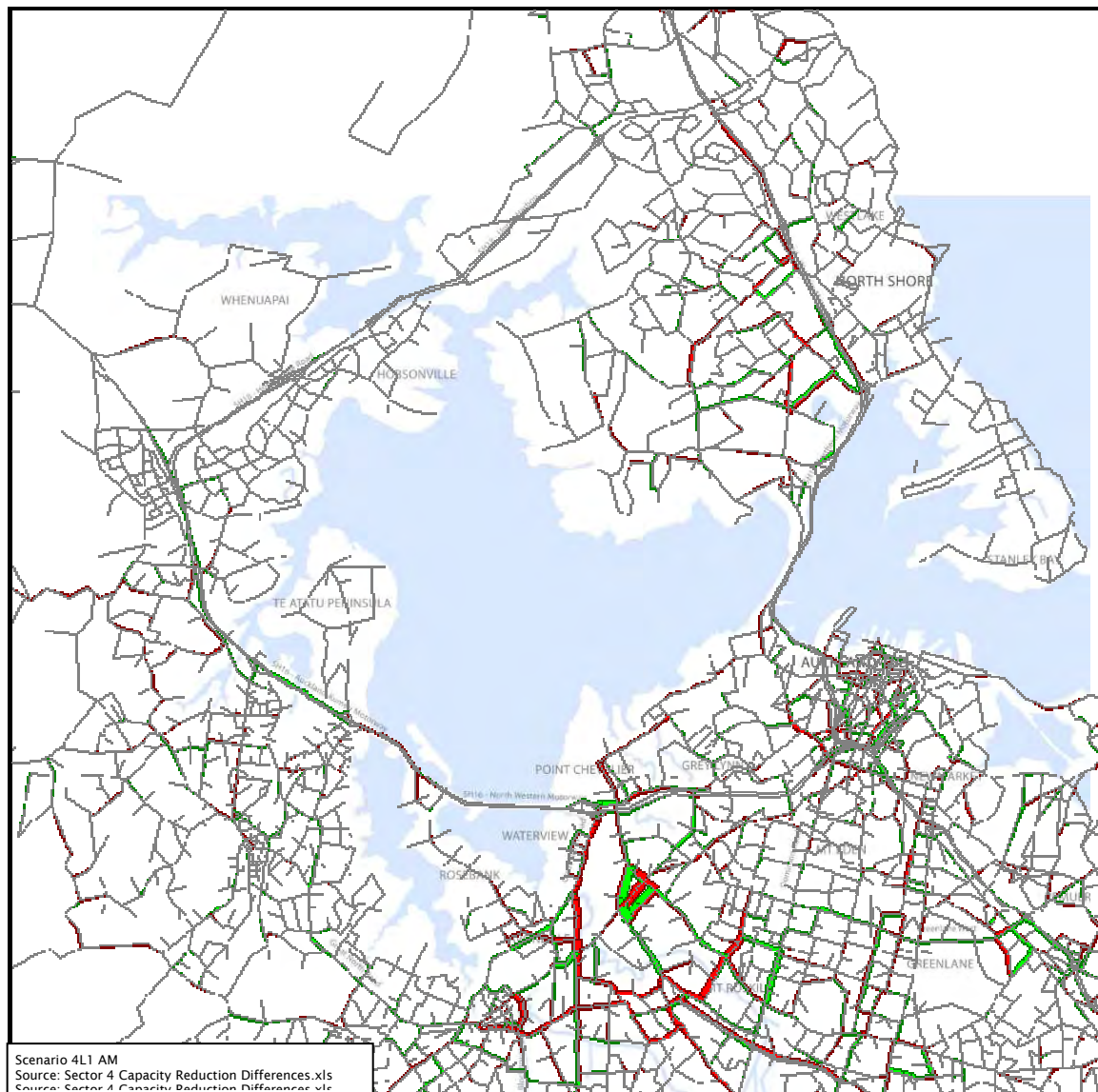
## 10.6 Identification and Mitigation of Traffic Effects

### 10.6.1 Impacts arising from the temporary work site

This section discusses the impact that the lane narrowing on SH16 at between Rosebank Interchange and Great North Road interchange is likely to have on the wider network.

As noted in **section 5** previously, a number of scenarios have been assessed in the project assignment traffic model, and the results of the capacity reduction scenarios in that model are discussed below.

**Figure 10-2** below indicates the impact (or lack thereof) from a capacity reduction on SH16 east of Patiki Interchange. In each of the figures, red denotes an increase in traffic flows, while green denotes a decrease in traffic flows.



**Figure 10-2 - AM Peak impact of capacity reduction on SH16 Eastbound east of Patiki Interchange**

This figure shows little change in traffic flows as a result of a reduction in capacity at the location discussed. This is because the location, east of the off-ramp, has lower flows than those to the west of the off-ramp upstream on SH16, which means there remains redundant capacity through this section. Therefore, this section of road is less sensitive to changes in roadway capacity.

**Figure 10-3** below indicates the effects reduction in capacity on SH16 Eastbound east of Rosebank Interchange is likely to have.



**Figure 10-3 - AM Peak impact of capacity reduction on SH16 Eastbound east of Rosebank Interchange**

This shows that a capacity reduction on the section of SH16 between Rosebank Interchange and Great North Road Interchange is likely to have localised impacts around Great North Road and through Rosebank Peninsula. This section of SH16 has reasonably accessible alternative routes and therefore the impacts are less pronounced compared to sections around Te Atatu Interchange and Great North Road Interchange.

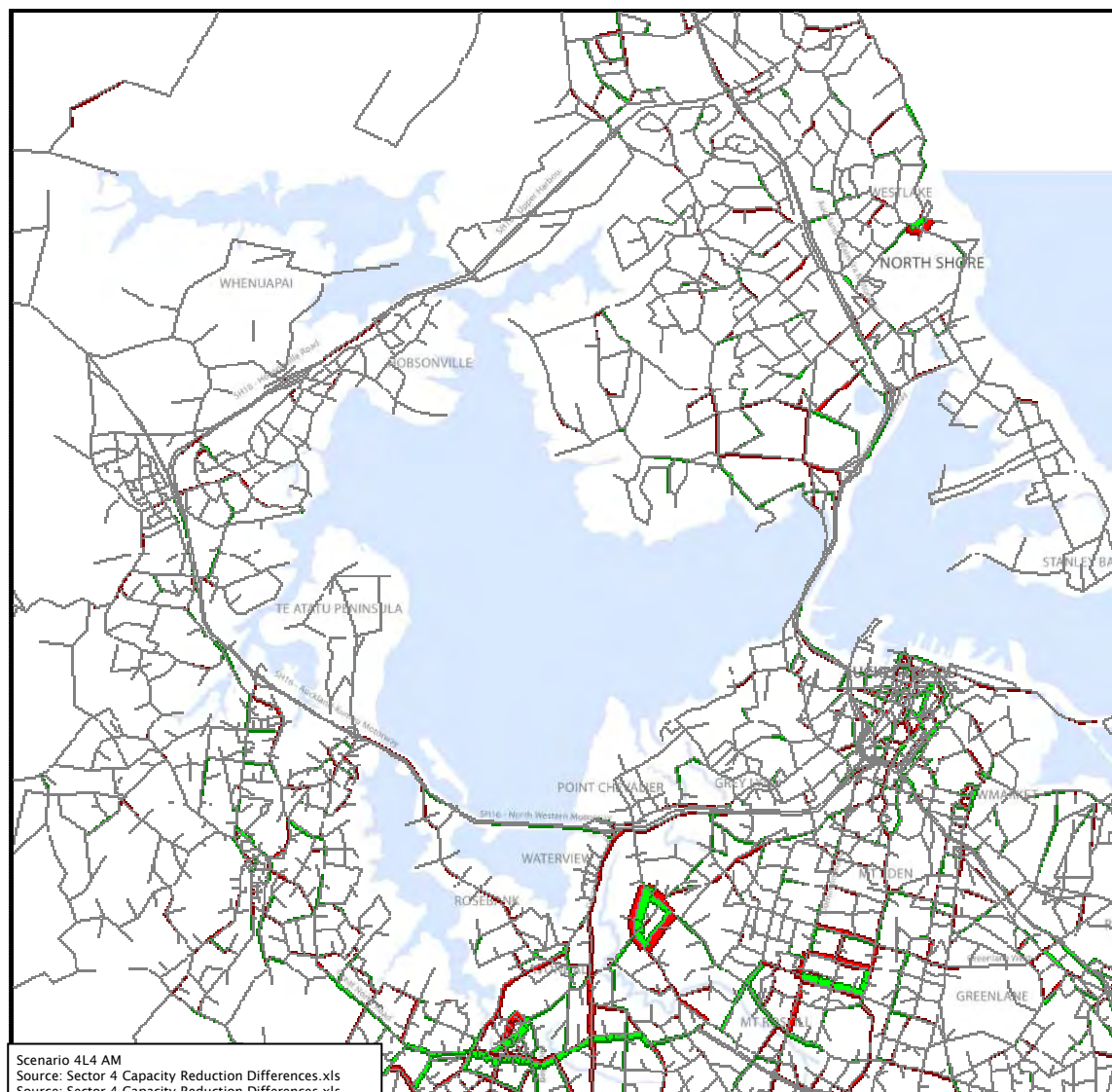
**Figure 10-4** below indicates the effects reduction in capacity on SH16 Eastbound east of Rosebank Interchange is likely to have on the network.



**Figure 10-4 - PM Peak impact of capacity reduction on SH16 Westbound east of Patiki Interchange**

Similarly to SH16 Eastbound on the same segment, this section is not sensitive to reduction in capacity due to the presence of the westbound Rosebank Off-Ramp allowing redundant capacity on this section.

**Figure 10-5** below indicates the effects reduction in capacity on SH16 Eastbound east of Rosebank Interchange is likely to have.



**Figure 10-5 - PM Peak impact of capacity reduction on SH16 Westbound east of Rosebank Interchange**

This scenario also indicates little change in traffic flows on SH16 as a result of a loss in capacity. This is likely to be because of congestion that occurs downstream at Te Atatu and Lincoln Interchanges that results in redundant capacity through this section in the PM peak. This result supports the anecdotal observations that it is the western interchanges on SH16 that constrain capacity and generate queues during the PM peak in the westbound direction.

Because of this, it is considered that it is the western end of the project, in Sector 1 at the Te Atatu Interchange and at the Whau River Bridge that careful planning and management of the site is undertaken.

It is also recommended that where possible, site access to the construction site along SH16 should be placed as far east as practicable in order to minimise disruption in the sensitive areas around Sector 1. For example,

access to the reclamation might be considered between the Rosebank and Patiki Interchanges if possible as this would present the lowest traffic impact, however this would need to be balanced with other considerations such as the environmental impact in accordance with the environmental management plan.

## 10.6.2 Impacts arising from temporary closures

### 10.6.2.1 Existing situation

This section provides an overview of the predicted night time traffic flows that are predicted to pass through Sector 4 during construction, and are therefore likely to be impacted by the works as a result of lane, ramp and mainline carriageway closures.

The following two figures,

**Figure 10-6** and **Figure 10-7**, show the traffic pattern of trips on SH16 between Rosebank Interchange and Great North Road Interchange.



Figure 10-6 - SH16 Eastbound East of Rosebank Interchange Traffic Pattern





**Figure 10-7 - SH16 Westbound East of Rosebank Interchange Traffic Pattern**

This shows a fairly even distribution of origins and destinations between each of the ramps on SH16, and also reflects the strategic nature of trips on this section of SH16, which are distributed well to the northwest and southeast.

This shows that it will be critical to communicate closures well in advance of actual implementation so that road users have an opportunity to adjust their trip timing or route, as they are unlikely to be able to alter their path at short notice or in close proximity to the closure. As such VMS messaging at the location of closures will be important in managing the effects of temporary closures, and are recommended to be implemented at least week in advance of the closure itself.

The construction works on the SH16 causeway will require a number of closures of the Patiki Road and Rosebank Road on and off ramps throughout construction. Select link analyses indicate that trips are more

frequently associated with the commercial activities along Rosebank Road in the interpeak. However, this pattern cannot be expected to be reflected in the evening due to the day-time nature of most of the businesses along Rosebank Road.

While the pattern of trips using Patiki and Rosebank Road interchanges at night is not well understood at this time, and surveys may be necessary to understand this impact during development of SSTMPs for closures of the ramps, night time traffic flows on these links are not expected to be high given the nature of land use in the area. In any case it is recommended road users are advised of off ramp closures at the previous interchange in advance of and during the closures.

The detour routes required for each ramp in the Rosebank and Patiki Interchanges are described in the following sections.

#### 10.6.2.2 Westbound Rosebank Interchange Off-Ramp

The off ramp traffic will be directed to exit SH16 at the Te Atatu Interchange. Traffic will then be directed back to Rosebank Road via the Te Atatu Interchange Eastbound Loop On-Ramp and the Patiki Road Off-Ramp.

#### 10.6.2.3 Eastbound Rosebank Road Interchange On-Ramp

The on ramp traffic will be directed to the Te Atatu Interchange Eastbound Loop On-Ramp. Access to Rosebank Road will be closed at the Patiki Road intersection and traffic will be directed to the Te Atatu Interchange via the Patiki Road On-Ramp and the Te Atatu Interchange Westbound Off-Ramp.

#### 10.6.2.4 Eastbound Patiki Road Interchange Off-Ramp

The off ramp traffic will be directed down the motorway to exit SH16 at the Great North Road Interchange and directed back onto SH16, though to the Rosebank Road (westbound) Off-Ramp. Traffic will be redirected from the Great North Road Interchange Off-Ramp back to the Great North Road Interchange On-Ramp at both ramp intersections with Great North Road.

#### 10.6.2.5 Westbound Patiki Road On-Ramp

The on ramp traffic will be directed to the Great North Road Interchange On-Ramp. Access to Patiki Road will be closed at the Rosebank Road intersection and traffic will be directed to the Great North Road Interchange via the Rosebank Road On-Ramp and the Great North Road Interchange Eastbound Off-Ramp.

### 10.6.3 Impacts on pedestrians and cyclists

The existing northwestern cycle way will be maintained throughout works on Sectors 3 and 4, and as such the impacts to pedestrians and cyclists using corridors in this sector are expected to be negligible.

#### 10.6.4 Impacts arising from site access

The location of the site access points, for each work zone, for each construction phase will be primarily from SH16. The site access points for each work zone will be positioned on the local road network where possible, however the majority of the works will be undertaken adjacent to the motorway lanes and are not accessible from the arterial network.

Site access points on SH16 will not be in operation during peak hour times. Truck movements to / from SH16 will be prohibited during peak periods (06:00 – 0:00 on SH16 Eastbound and 15:00 – 18:00 on SH16 Westbound), and will require escorted exit/entry at other times, the requirements of which will be agreed with the RCA in advance of works commencing on site. Where acceleration and deceleration lanes cannot be provided for site access points on SH16, temporary lane closures may be installed outside of peak hour traffic periods to provide acceleration and deceleration lengths.

As noted previously, it will be desirable to locate accesses as far east as practicable so as to minimise interaction between site vehicles and the more sensitive areas to the west along the Whau River Bridge and Te Atatu Interchange. It is preferable that site accesses provided off SH16 are provided between the Patiki and Rosebank Interchanges, provided adequate sight distance can be provided.

The site access points on the local network will be designed in accordance with COPTTM and consider turning bays for vehicles entering the access and shall provide appropriate visibility.

#### 10.6.5 Impacts on public transport

It is expected there will be some effects on the operation and performance of buses during works on Sector 4. As noted previously, the existing bus shoulders on SH16 Eastbound will be removed during the first two phases of works, which will mean that buses will lose approximately 3km of free-flow speeds through the site during congested periods.

It is necessary to remove the bus lanes to facilitate works, however the effect on buses will be mitigated where possible through:

- Reinstatement of bus lanes and / or priority as rapidly as possible as works allow;
- By liaising with passenger transport authorities and operators throughout the works to arrange alternative or mitigating measures for buses through the work; and
- By providing alternative means of priority to minimise delays, which may include modification of priority at ramps, or provision of sections of bus lanes through the site where feasible.

## 11. Sector 5 – Great North Road Interchange

### 11.1 Preliminary Traffic Management Methodology

The majority of the works to the Great North Road Interchange will be constructed off-line and during the night. The portions of the Interchange which affect the existing road environment will be constructed by realigning the existing roads by re-marking lanes and installing safety barriers to open up work zones to allow off-line construction. The activities directly adjacent to SH16 will be typically conducted under night closures of the motorway.

Construction of the SH20 – SH16 ramps in Sector 5 will largely be undertaken off-line which will not affect motorway or arterial alignments. Work in the median and on structures over live carriageways will be undertaken during night time lane and full closures. The site will be made safe and maintained in accordance with COPTTM throughout the day.

**Figure 11-1** below indicates the extent of works in Sector 5.



**Figure 11-1 – Overview of works at Great North Road Interchange**

Work on the motorway to motorway ramps that intersect existing interchange carriageways will be undertaken under two phases of minor mainline and ramp realignments with associated lane and shoulder narrowing. In the first stage, works in the left hand side of both carriageways will be completed, followed by works in the median of SH16.

The realignment of the westbound off-ramp will be undertaken under two phases with work completed on the southern (left hand shoulder) of the ramp, followed by work in the off-ramp gore area between the off-ramp and SH16 Westbound carriageway.

Construction of the new SH16 Eastbound motorway to motorway on-ramp will be completed through implementation of lane and shoulder narrowing on SH16 Westbound.

The existing number of lanes on the mainline and on the ramps will remain operational throughout works, and the carriageway narrowed to a minimum of 3.25m lanes and shoulders to a minimum of 0.3m, and 0.5m where possible. Where shoulder narrowing is implemented, opportunities for providing emergency stopping bays for incidents, breakdowns and emergency services will be investigated and implemented where they can be facilitated by the work site.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary for site access from the motorway.

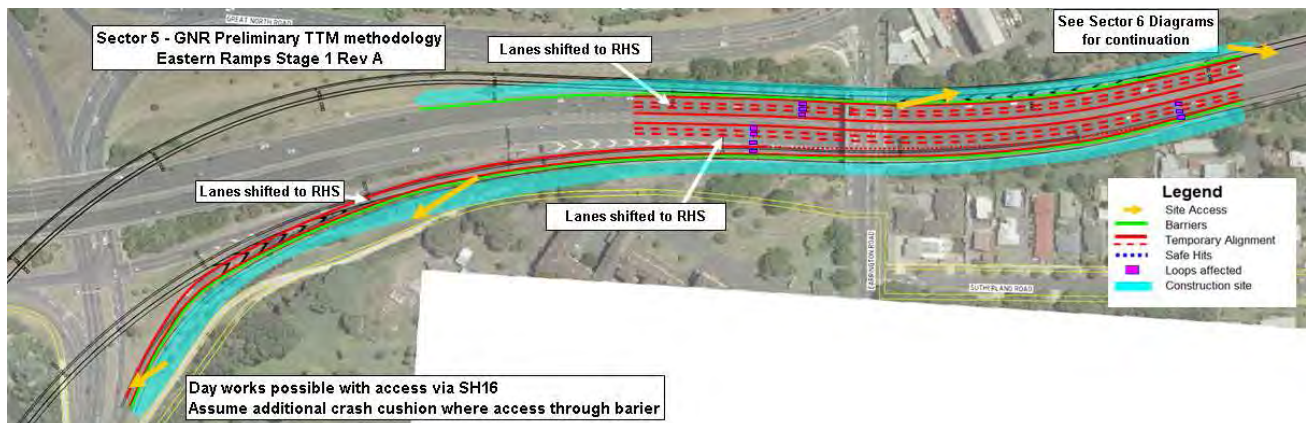
Construction site access will typically be undertaken from Great North Road, where possible, with limited movements from the existing interchange ramps or SH16.

Truck movements to / from SH16 or the interchange ramps will require escorted entry / exit during peak periods (6am – 9am on SH16 Eastbound and 3pm – 6pm on SH16 Westbound), the requirements of which will be agreed with the RCA in advance of works commencing on site.

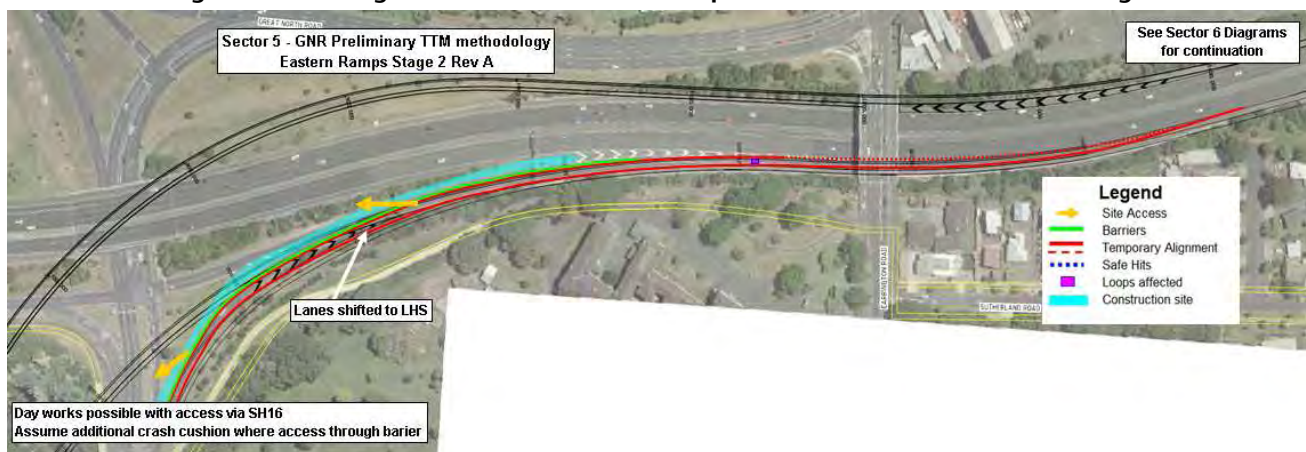
The works will be staged from the construction yard accessed from Great North Road (south of SH16). Site accesses to the compound will be designed and managed to minimise the effect on the road network, which will be agreed with ACC and / or NZTA's network maintenance consultant in a SSTMP prior to start of works.

#### 11.1.1 Great North Road Interchange Eastern Ramps

The new Great North Road Interchange Eastern Ramps will be constructed under two stages as shown in **Figure 11-2** and **Figure 11-3** below.



**Figure 11-2 – Stage 1 works on Eastern Ramps at Great North Road Interchange**



**Figure 11-3 - Stage 2 works on Eastern Ramps at Great North Road Interchange**

Under the first stage the SH16 lanes and shoulders past the eastern ramps will be narrowed and shifted towards the median. The westbound off-ramp will also be narrowed and shifted to the northern side of the carriageway. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The work zones will be accessed by site access points at either end of the area in the direction of the motorway flow on SH16 in the eastbound direction and on the westbound off-ramp.

Under stage two the SH16 lanes and shoulders past the eastern ramps will be marked in their final arrangement. The westbound off-ramp will also be shifted to the southern side of the carriageway and the existing right turn on to Great North Road will be closed permanently. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The work zone north of the westbound off-ramp will be accessed in the direction of the off ramp flow, entering at the east end from the ramp and exiting to Great North Road.

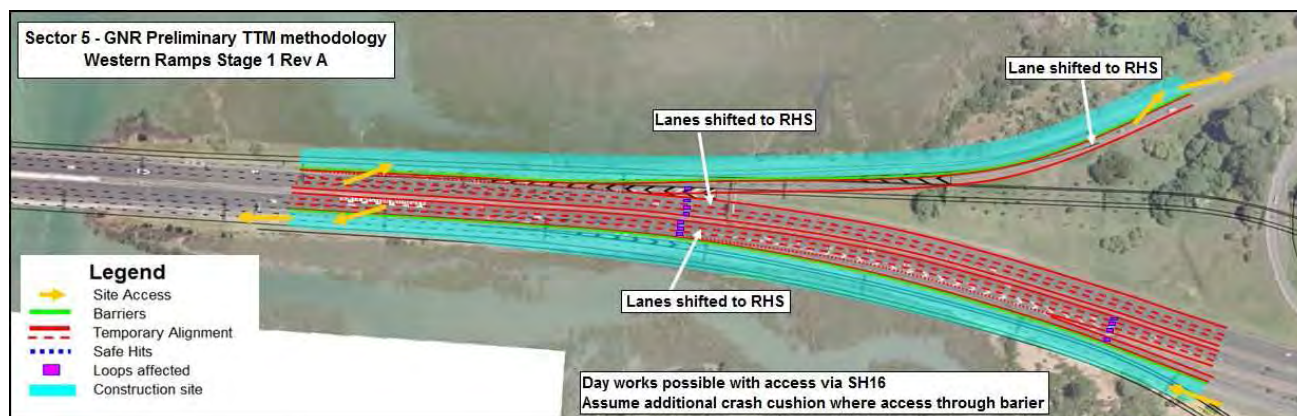
Once the bridge and ramp construction works are complete, the final surfacing and pavement marking will be installed over a number of nights using lane closures.



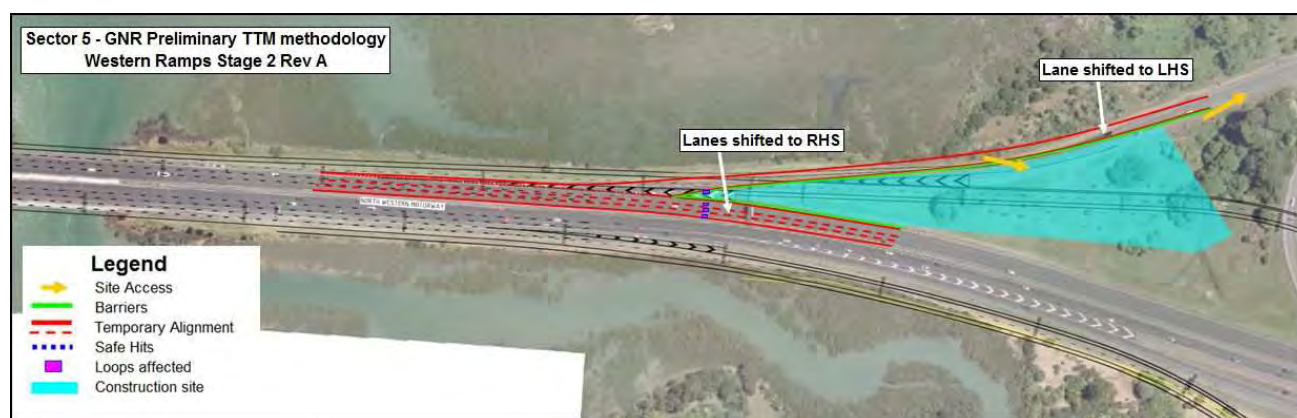
### 11.1.2 Great North Road Interchange Western Ramps

The new Great North Road Interchange Western Ramps will be constructed under two stages as shown in **Figure 11-4** and

**Figure 11-5** below.



**Figure 11-4 – Stage 1 works on Western Ramps at Great North Road Interchange**



**Figure 11-5 – Stage 2 works on Western Ramps at Great North Road Interchange**

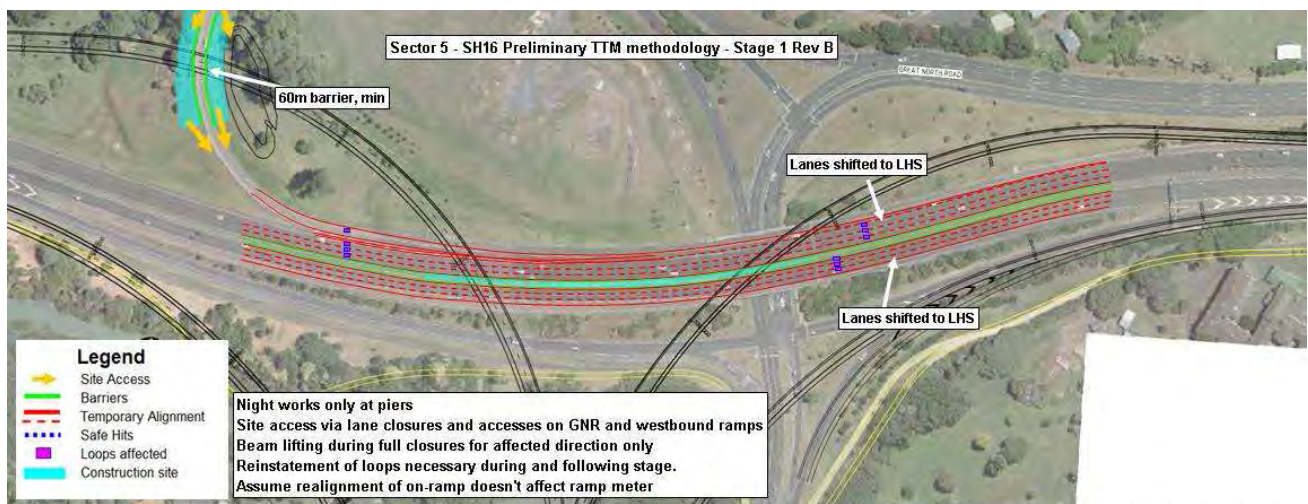
Under the first stage the SH16 lanes and shoulders past the western ramps will be narrowed and shifted towards the median. Both the existing ramps will also be narrowed and shifted toward the median. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The work zones will be accessed at either end of the area in the direction of the motorway flow on both ramps. Pedestrians and cyclists will be diverted around the work zone south of the existing Western On-Ramp on a temporary footpath/ cycle lane until the new footpath/ cycle lane is commissioned.

Under stage two the westbound SH16 and on ramp lanes past the western ramps will be marked in their final arrangement. The eastbound off-ramp will also be shifted to the northern side of the carriageway to allow construction to the south. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The eastbound off-ramp work zone will be accessed in the direction of the off ramp flow, from the off ramp.

Once the eastbound off-ramp and bridge construction works are complete, the final surfacing and pavement marking will be installed over a number of nights using lane closures.

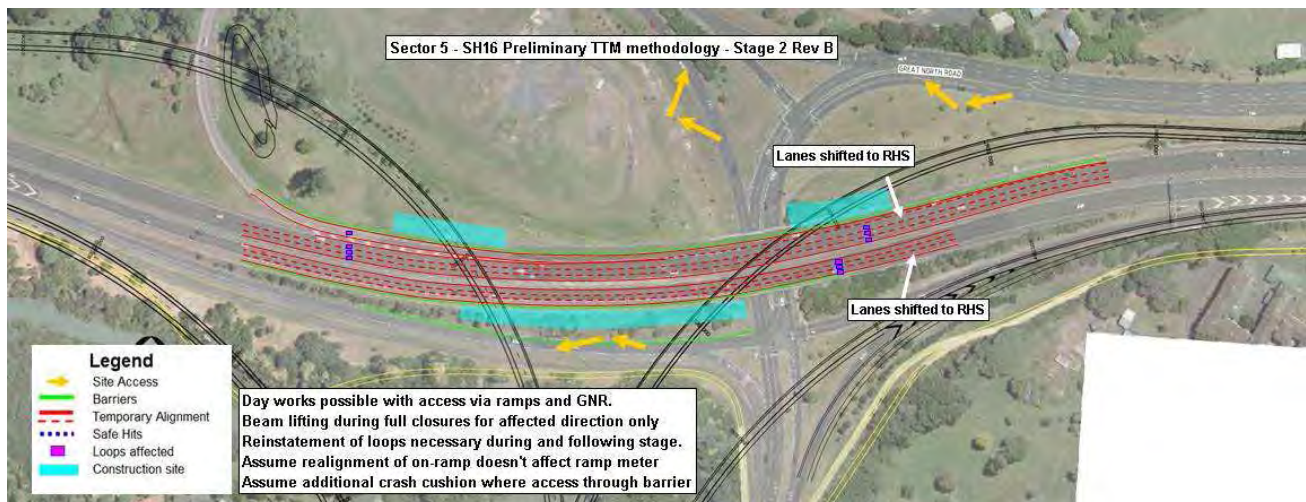
### 11.1.3 SH16 and Ramps

The construction of the new Great North Road Interchange ramp bridges will be constructed under two stages as shown in **Figure 11-6** and **Figure 11-7** below.



**Figure 11-6 – Stage 1 works at Great North Road Interchange**





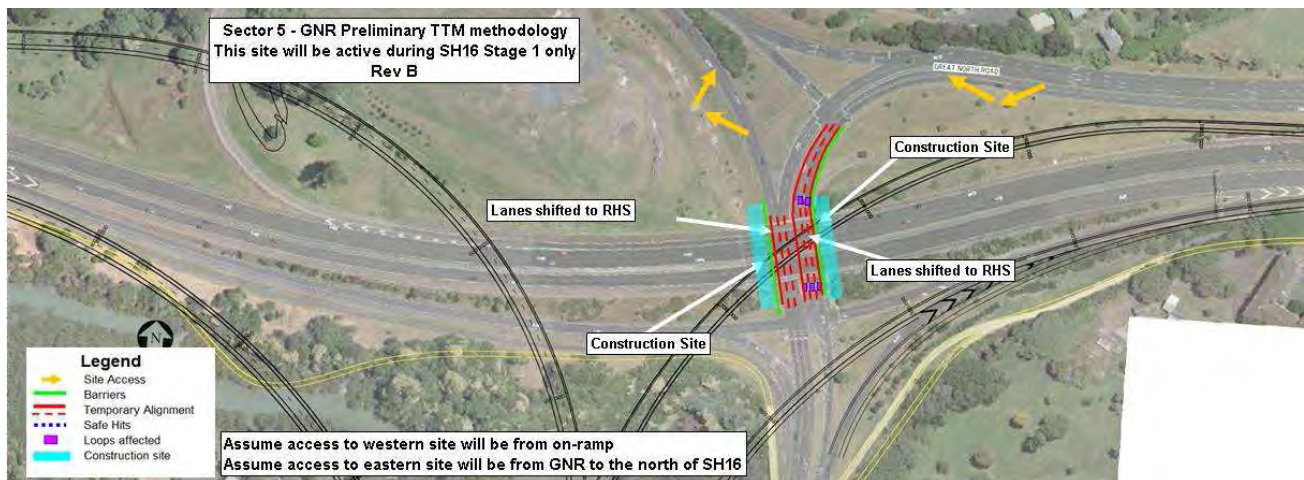
**Figure 11-7 – Stage 2 works at Great North Road Interchange**

Under the first stage the SH16 lanes and shoulders through the interchange will be narrowed and shifted away from the median to allow construction of the new median abutments. Work zones will also be set up, without adjusting the current lane width, either side of the interchange ramps where the new ramps cross. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The work zones will be accessed at either end of the area in the direction of the motorway flow in the SH16 median and on each affected ramp. The bridge beams will be lifted in to position over each section of road under a full road closure and detour at night.

Under stage two the SH16 lanes and shoulders through the interchange will be shifted toward the median to allow construction of the new abutments adjacent to SH16. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The work zones adjacent SH16 will be accessed in the direction of flow, from the westbound off-ramp, eastbound loop on-ramp, and the westbound direction on Great North Road.

Once the bridge construction works are complete, the final surfacing and pavement marking on SH16 will be installed over a number of nights using lane closures.

A work site will also be set up on Great North Road beneath SH16 as the piers for the new structures are expected to extend down through the existing bridge over Great North Road and will require work zones adjacent to Great North Road. The work zone is shown in **Figure 11-8** below.



**Figure 11-8 – Stage 1 works at Great North Road Interchange on Great North Road during Stage 1 works on SH16**

This work site may require narrowing of lanes on Great North Road, and temporary barriers to protect the work zone from passing vehicles. The work sites created on both sides of Great North Road will be accessed from Great North Road and the SH16 Eastbound Great North Road On-Ramp. Following completion of pier works, the road will be reinstated to the existing road layout and re-surfaced.

## 11.2 Identification and Mitigation of Traffic Effects

### 11.2.1 Impacts arising from the temporary work site

The temporary work sites set up to facilitate works in Sector 5 are not expected to have significant impact on the capacity of SH16, and are of significantly shorter duration than those on to the west in Sectors 1 – 4. This is because:

- The duration of ramp construction over the SH16 and adjacent to the ramps is expected to occur over a number of weeks or months;
- Lane narrowing is not anticipated through the interchange as these works will be undertaken under night closures as opposed to daytime offline activities such as those in Sector 4;
- Lane narrowing is anticipated for construction of the western and eastern ramps, however for the purposes of this assessment the impacts of those activities have been adequately assessed in the discussions about Sectors 4 and 7:
  - In the case of the western ramps, lane narrowing is anticipated in the vicinity of the west facing Great North Road interchange ramps, which is reflected in the lane narrowing discussion and figures in section 7.2.1 previously.

- In the case of the eastern ramps, lane narrowing is anticipated in the vicinity of the east facing Great North Road interchange ramps, which is reflected in the capacity reduction discussion and figures in section 12.2.1 below.

## 11.2.2 Impacts arising from temporary closures

### 11.2.2.1 Existing situation

This section provides an overview of the night time traffic flows that are predicted to pass through Sector 5 during construction, and are therefore likely to be impacted by the works as a result of lane, ramp and mainline carriageway closures.

**Figure 11-9** below shows the SH16 Westbound Great North Road Interchange On-Ramp traffic pattern. It is this traffic that will need to be provided for in diverting traffic away from closures of the ramp and communicated with in advance and during the closure.



**Figure 11-9 - SH16 Westbound Great North Road Interchange On-Ramp Traffic Pattern**

This shows the strategic nature of trips that use the Great North Road interchange. There is a significant proportion of trips that pass through the Great North Road interchange that have originated from SH20 and continue onward to the far end of SH16, to the Te Atatu and Lincoln Interchanges.

**Figure 11-10** below shows the SH16 Westbound Great North Road Interchange Off-Ramp traffic pattern.



**Figure 11-10 - SH16 Westbound Great North Road Interchange Off-Ramp Traffic Pattern**

This also reflects the strategic nature of trips that use the Great North Road interchange. There is a significant proportion of trips that pass through the Great North Road interchange that have originated from both the southern and northern motorways.



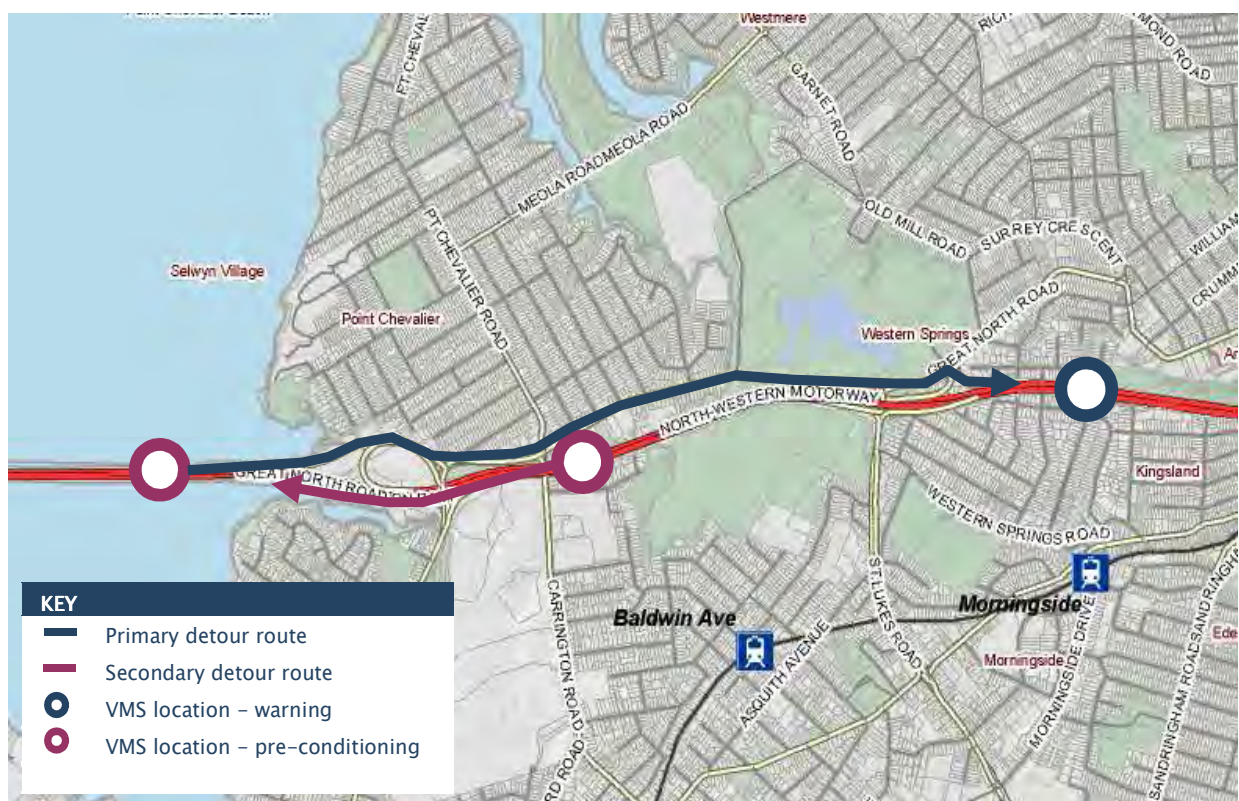
### 11.2.3 Impacts arising from temporary closures

The construction works at the Great North Road Interchange will require a number of closures of the SH16, on and off ramps, and Great North Road during bridge construction over the road. Closures will be restricted to night time only, likely to be no earlier than 9:00pm and will be lifted by 5:30am the following morning on Sunday – Thursday nights only. Timing of closures will be based on a balance between the noise requirements and consideration of traffic volumes, and will be planned and implemented in accordance with the construction environmental management plan and the CTMP under an approved SSTMP.

Motorists will be advised of off-ramp closures at the previous interchange in advance of and during the closures. Traffic will be directed down the following detour routes when each road is closed.

#### 11.2.3.1 SH16 between the on and off ramps

All SH16 traffic will be directed off at the Great North Road off ramps, as shown in **Figure 11-11** below. Westbound traffic will be directed through to the Great North Road Interchange On-Ramps and eastbound will be directed through to the St Lukes On-Ramp via Great North Road. The signals along Great North Road will be optimised to allow the traffic to continue to flow efficiently with the additional demand.



**Figure 11-11 – SH16 Mainline Detour Routes**

### 11.2.3.2 Great North Road

All southbound traffic on Great North Road will be diverted off at Carrington Road and back to Great North Road via New North Road (refer **Figure 11-12**).



**Figure 11-12 – Great North Road Southbound Detour Routes**

All northbound traffic on Great North Road, including the Great North Road Interchange Eastbound On-Ramp traffic, will be diverted onto the Great North Road Interchange Westbound On-Ramp. The traffic will be diverted to the Te Atatu Interchange where it will be directed back on at the Te Atatu Interchange eastbound loop on-ramp and back along SH16 Eastbound. Warning signage will be placed on Great North Road and Blockhouse Bay Roads to minimise inconvenience to road users wishing to head east from Great North Road interchange along Great North Road or the eastbound on-ramp. This is shown in **Figure 11-13** below.



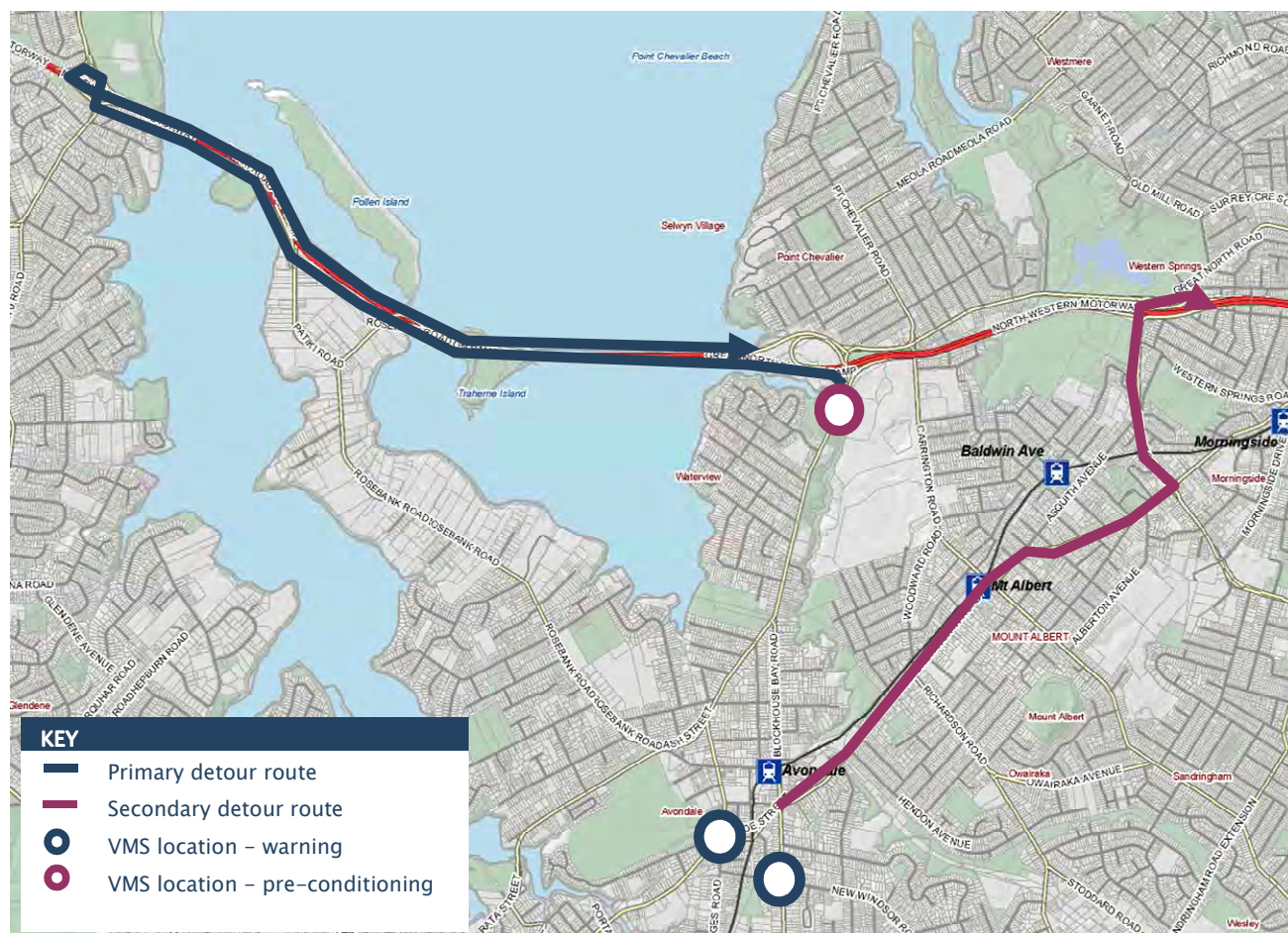


Figure 11-13 – Great North Road Northbound Detour Route

### 11.2.3.3 Great North Road Interchange Westbound Off-Ramp

The off-ramp traffic will be directed to exit SH16 at the Te Atatu Interchange. Traffic will then be directed back to Great North Road via the Te Atatu Interchange Eastbound Loop On-Ramp and the Great North Road Interchange Westbound Off-Ramp. Due to the length of this detour, an alternative route will be recommended east of St Lukes interchange, as shown in **Figure 11-14** below.





**Figure 11-14 – Great North Road Interchange Westbound Off-Ramp detours**

#### 11.2.3.4 Great North Road Interchange Eastbound On-Ramp

The on-ramp traffic will be directed to the St Lukes Eastbound On-Ramp via Great North Road. If necessary, the signals along Great North Road will be optimised to allow the traffic to continue to flow efficiently with the additional demand.

#### 11.2.3.5 Great North Road Interchange Eastbound Off-Ramp

All Eastbound Off-Ramp traffic will be diverted back to the Great North Road Interchange Westbound Off-Ramp via Great North Road and the St Lukes On-Ramp. Warning signage will be provided on SH16 west of the Patiki Interchange to minimise inconvenience to road users who would otherwise use Great North Road to head south, as shown in **Figure 11-15** below.



**Figure 11-15 – Great North Road Interchange Eastbound Off-Ramp detour**

#### 11.2.3.6 Great North Road Interchange Westbound On-Ramp

The on-ramp traffic will be directed to the St Lukes Westbound On-Ramp via Great North Road. If necessary, the signals along Great North Road will be optimised to allow the traffic to continue to flow efficiently with the additional demand.

#### 11.2.4 Impacts on pedestrians and cyclists

The existing northwestern cycle way will be maintained throughout works on Sector 5, and as such the impacts to pedestrians and cyclists on in this sector are expected to be negligible.

#### 11.2.5 Impacts arising from site access

The site access points for each work zone are described in section 11.1 above. The site accesses are located at a number of locations throughout the interchange, with each ramp and carriageway likely to require site access from time to time.

It is expected that the inside of the SH16 Eastbound On-Ramp loop will be used as a laydown area for storage of materials and for staging of works. This site shall be accessed from an access entering from the left hand side of the on-ramp, within the loop. This site access shall be located so that sufficient sight distance is provided to the access in accordance with the SHGDM and if necessary deceleration and acceleration lanes shall be provided to minimise the speed differential between site vehicles and on-ramp traffic.

Site access points on SH16 will not be in operation during peak hour times. Where acceleration and deceleration lanes cannot be provided for site access points on SH16, temporary lane closures may be installed outside of peak hour traffic periods to provide acceleration and deceleration lengths.

The site access points on the local network will be designed in accordance with COPTTM and consider turning bays for vehicles entering the access and shall provide appropriate visibility.

#### 11.2.6 Impacts on public transport

Works on Sector 5 are anticipated to have negligible impact on public transport. This is because there are few (if any) public transport priority measures affected in this sector and a majority of the works on the interchange are expected to be conducted at night, during which time there are few public transport services.

## 12. Sector 6 – SH16 to St Lukes

### 12.1 Preliminary Traffic Management Methodology

The construction of the Great North Road Interchange eastern ramps is planned to occur under a number of phases. SH16 is expected to be realigned under a number of phases by re-marking lanes and installing safety barriers to open up work zones to allow off-line construction. The northern Carrington Road bridge abutment widening is envisaged to be carried out without significantly affecting Carrington Road or SH16.

Construction of the widening of SH16 in Sector 6 will be undertaken under shoulder closures with minor mainline and ramp realignments and associated lane and shoulder narrowing.

Work on SH16 widening will require work on the Carrington Road Bridge abutments. The works will be carried out while maintaining pedestrian and vehicle access on Carrington Road.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary for site access from the motorway.

Truck movements to / from SH16 or the interchange ramps will require escorted entry / exit during peak periods (6am – 9am on SH16 Eastbound and 3pm – 6pm on SH16 Westbound), the requirements of which will be agreed with the RCA in advance of works commencing on site.



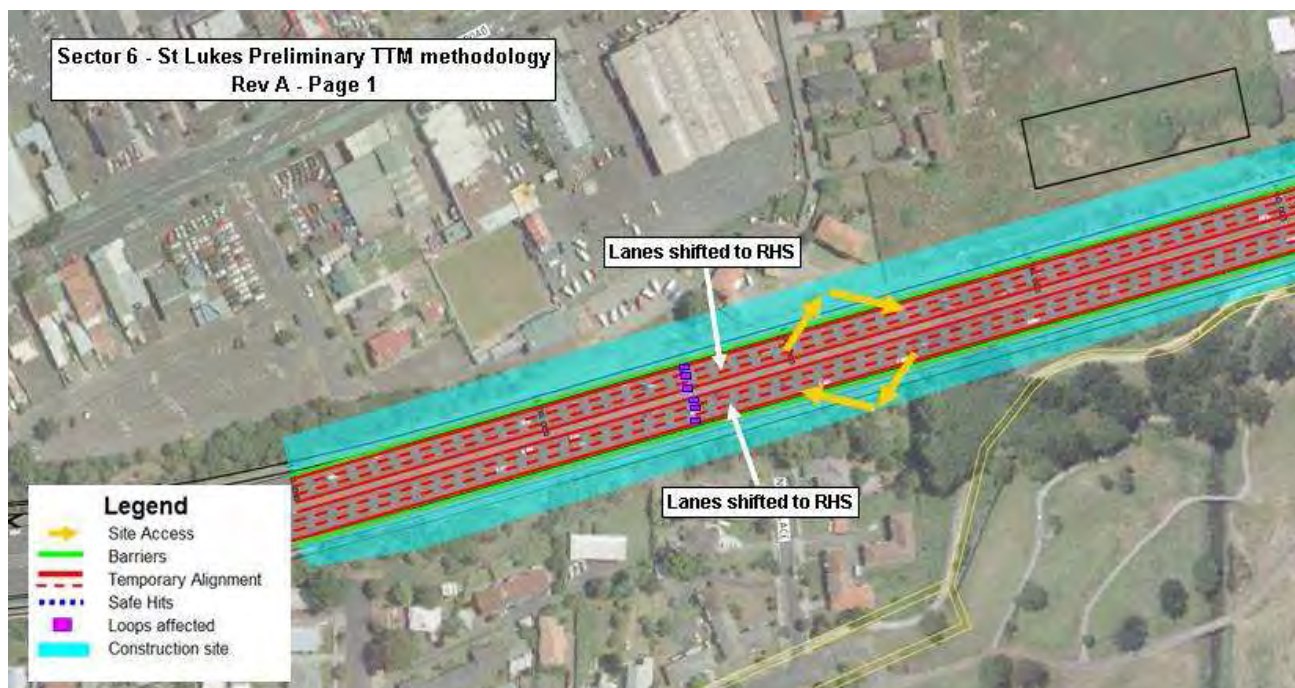


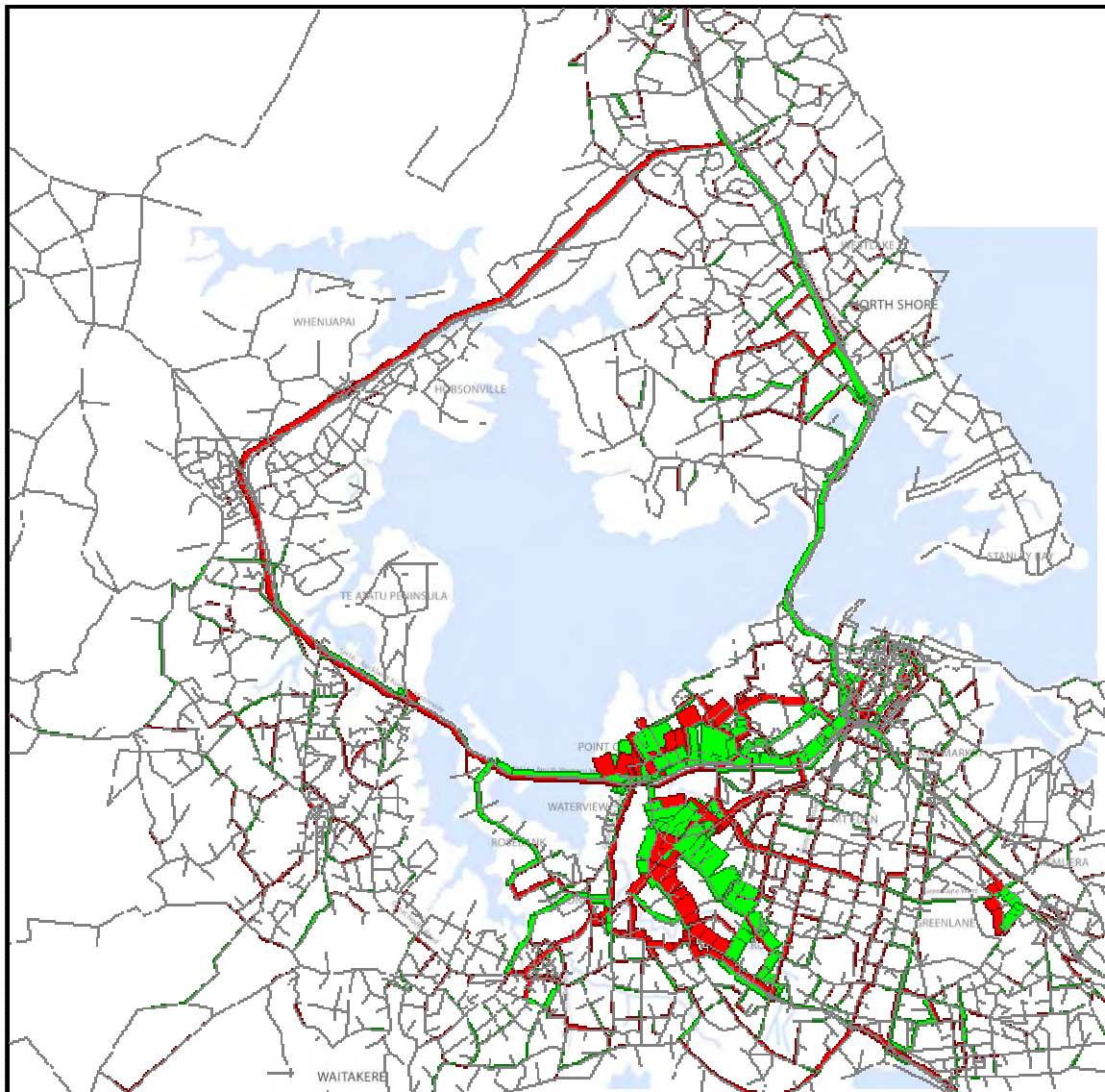
Figure 12-1 – Conceptual construction methodology on SH16 to St Lukes

## 12.2 Identification and Mitigation of Traffic Effects

### 12.2.1 Impacts arising from the temporary work site

The location of the site access points for each work zone, for each construction phase is shown on the **Figure 12-1** above. The site access points for each work zone will be positioned on the local road network where possible, and it is understood that site access to a construction yard for the work site in Sector 6 will be provided off Great North Road opposite Moa Road. Site access points on SH16 will not be in operation during peak hour times. The site access points on the local network will be designed in accordance with RCA requirements and consider turning bays for vehicles entering the access and appropriate visibility.

**Figure 12-2** below indicates the effect of reducing the capacity on SH16 Eastbound to the east of the Great North Road interchange (i.e. between SH16 Eastbound Great North Road On-Ramp and the SH16 Eastbound Western Springs Off-Ramp) during the AM Peak. In each of the figures, red denotes an increase in traffic flows, while green denotes a decrease in traffic flows.



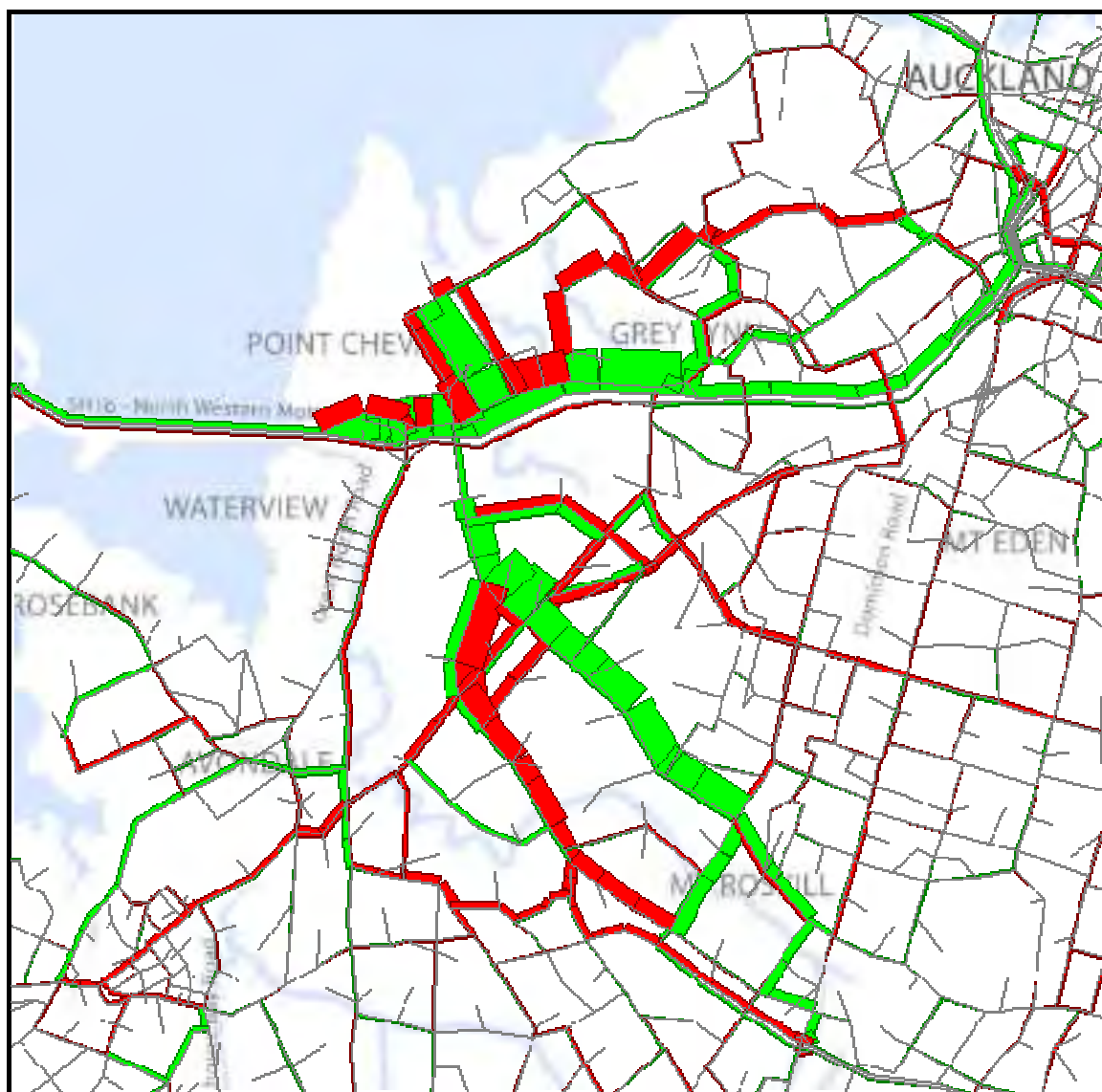
**Figure 12-2 – AM Peak impact of capacity reduction on SH16 Eastbound**

This shows that a decrease in the east bound capacity of SH16 east of the Great North Road interchange is likely to result in network effects across the Auckland region during the AM peak.

Broadly speaking, such a capacity reduction will result in ‘marginal’ trips that only benefit a small amount through the use of that link relocating onto alternative routes. These are trips that have a close to 50 / 50 decision between two alternative routes, and once the travel time on one route increases a small amount they will typically shift to an alternative without a large impact on their overall travel time. Issues arise however where feasible alternative routes are not possible or are heavily congested.

The model shows an increase in traffic flows on SH16 Westbound and SH18 can be expected, with a corresponding reduction in traffic flows on the Auckland Harbour Bridge (AHB). Relocation of these trips would have a positive effect on the performance of the AHB and CMJ, and should therefore be a primary group to which communications should be addressed in mitigating the impact of changes to capacity on SH16 eastbound. This could be achieved through installation of signage on the Northwest to North Link or the North to Northwest Link in CMJ.

**Figure 12-3** below provides a more zoomed view of Figure 12-2 in the immediate vicinity of the Great North Road interchange and the affected segment.



**Figure 12-3 – AM Peak impact of capacity reduction on SH16 Eastbound**

As can be expected, a reduction in capacity to the east of the Great North Road interchange will result in a higher number of trips exiting SH16 at the eastbound Great North Road off-ramp. This traffic appears to re-distribute through a number of alternative routes through Pt Chevalier and Great North Road, which will need to be monitored carefully and measures developed to mitigate these effects if necessary. Great North Road could provide a feasible alternative route in this case, however the effect on that corridor would need to be carefully weighed against the disbenefits to traffic approaching along Great North Road to the south.

The model predicts that a number of roads will experience changes in flow in the vicinity of Richardson Road and Carrington Road; however it is thought this is related to instability in the model and as such is not expected to be realised as a result of the changes to SH16 Eastbound. This would have been precipitated by diversion of traffic away from SH16 onto the local network, and reflects the fact that redistribution can be expected to increase when capacity on the motorway is affected by works.

**Figure 12-4** below indicates the effect of reducing the capacity on SH16 Westbound to the east of the Great North Road interchange (i.e. between SH16 Westbound Great North Road Off-Ramp and the SH16 Westbound St Lukes On-Ramp) during the AM Peak.

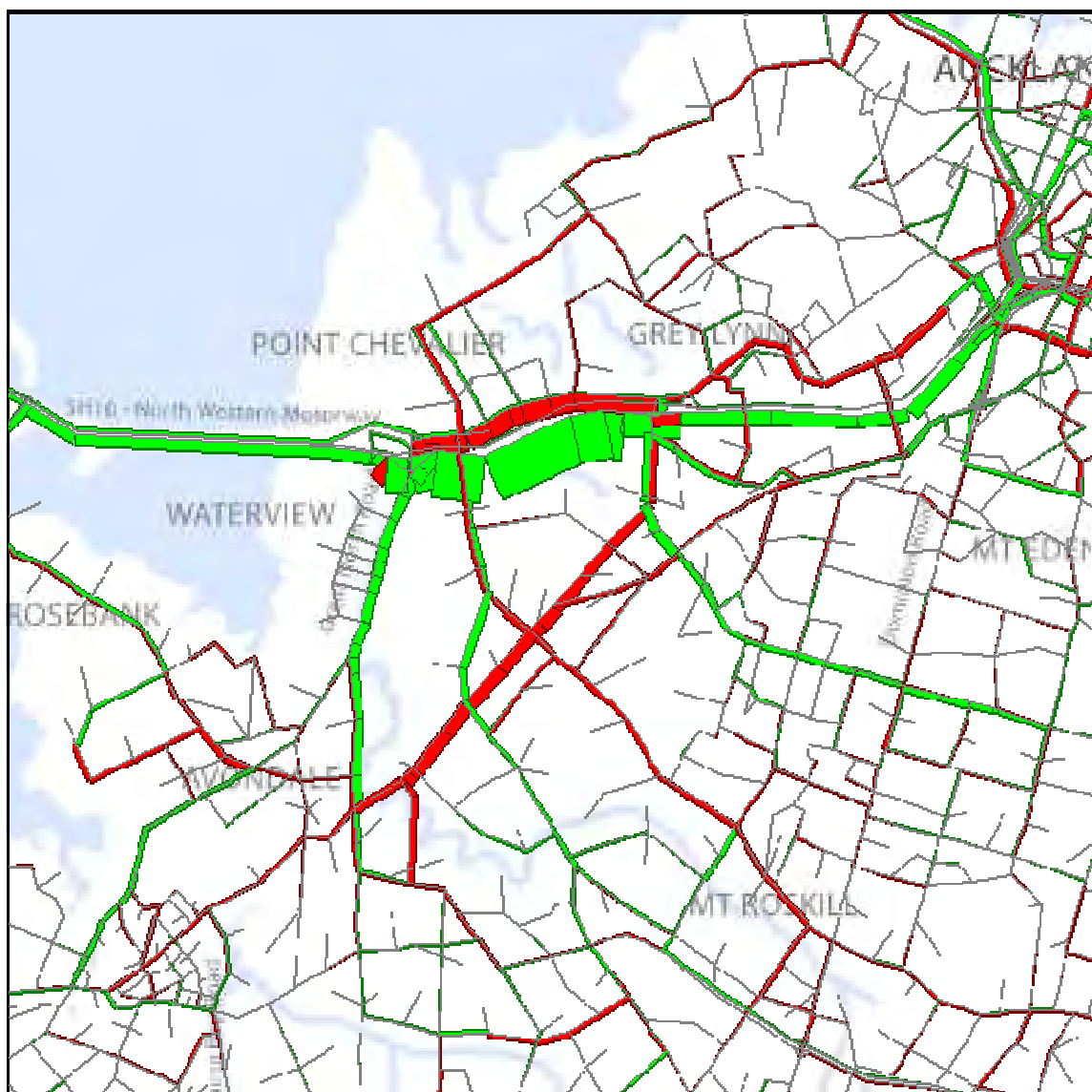




The model predicts a range of effects across the Auckland Isthmus, however particularly in the vicinity of the lane narrowing along Great North Road (to the north of SH16) and New North Road through Morningside and towards New Lynn. This route will need to be reviewed in advance of the works to mitigate the effect on these

alternative routes. Mitigation for this might include route optimisation through the signals along New North Road to minimise the effect of the diverted traffic on existing travel times and capacity. This would be conducted by NZTA's appointed contractor in accordance with the CTMP and in agreement with the RCA.

**Figure 12-5** below indicates the more localised effects of the reduction in capacity on SH16 Westbound.



**Figure 12-5 – Local PM Peak impact of capacity reduction on SH16 Westbound**

This reinforces that a number of alternative routes will experience an increase in traffic flows as a result of a reduction in capacity on SH16 Westbound east of the Great North Road interchange, in particular Great North Road (north of SH16) and New North Road.

It is also noted that Jervois Road and Meola Road, the route through Herne Bay and Pt Chevalier, can be expected to experience some additional flow as a result of the reduction in capacity.

## 12.2.2 Impacts arising from temporary closures

### 12.2.2.1 Existing situation

This section provides an overview of the predicted night time traffic flows that predicted to pass through Sector 6 during construction, and are therefore likely to be impacted by the works as a result of lane, ramp and mainline carriageway closures.

**Figure 12-6** below show the traffic pattern during the PM peak on SH16 Westbound East of the Great North Road Interchange.



**Figure 12-6 - SH16 Westbound East of Great North Road Interchange Traffic Pattern**

This reflects the strategic nature of the trips passing through the Sector 6 work site, as many of the trips that pass through the selected link are from the northern and southern motorway, and a high proportion of the trips continue to Te Atatu interchange or beyond. This means that region-wide communications and road user education will be necessary for mitigating the effect of closures in order to minimise demands and inconvenience to road users during construction.

**Figure 12-7** and **Figure 12-8** below indicates the SH16 Westbound St Lukes On-Ramp and Eastbound Off-Ramp traffic patterns.

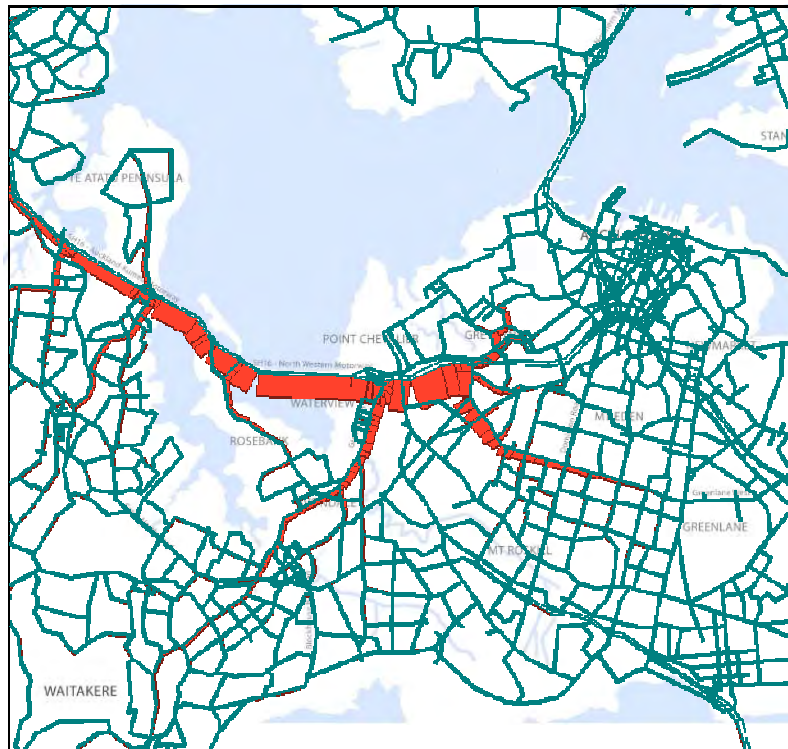


Figure 12-7 – St Lukes Interchange Westbound On-Ramp Traffic Pattern



**Figure 12-8 – SH16 Western Springs Off-Ramp Traffic Pattern**

These diagrams show that the traffic patterns associated with St Lukes interchange are closely linked to Great North Road and locations further to the west.

As such, communications for these ramps would best be undertaken on the motorway to the west of the interchange in order to reach the widest road user audience.

#### 12.2.2.2 Detour Routes

Closures of SH16 may be necessary for works on the Carrington Road Bridge, in which case detours would be put in place that divert traffic onto Great North Road, which is a relatively simple and short detour route. Closures would be installed during night time only as traffic flows allow and in accordance with the environmental management plan and CTMP.

Closures of the Eastbound Western Springs Off-Ramp are not anticipated at this time, however if necessary the detour would be via Newton Road and back to St Lukes Interchange via SH16 Westbound.

Closure of the westbound St Lukes On-Ramp can be expected for pavement works, site mobilisation and works associated with the widening. This traffic would be diverted to the Great North Road Interchange Westbound On-Ramp via Great North Road.

### 12.2.3 Impacts on pedestrians and cyclists

Works on Sector 6 will be primarily undertaken on the motorway corridor and as such the impacts on pedestrians and cyclists in this sector are expected to be negligible. The existing northwestern cycle way on the southern side of SH16 will not be affected by the works.

### 12.2.4 Impacts arising from site access

Site access will be undertaken from two main locations, from the access on Great North Road opposite Moa Road, and also from site accesses located on SH16.

The site access on Great North Road will be installed under an approved SSTMP, and consideration will be given to banning right hand movements in and out of the access for trucks. The site access will be monitored following installation to determine methods for mitigating any identified traffic impacts.

### 12.2.5 Impacts on public transport

There are no public transport priority measures through Sector 6, and as such the impacts to services (apart from any effect on the general stream of traffic) are expected to be minimal.



### 13. Overview of SH20 Traffic Impacts and Proposed Strategic Mitigation Measures

The Project will see the northern extension of SH20 from the Maioro Street Interchange to connect with SH16 at the Great North Road Interchange. The Project includes three sectors of work on SH20, namely the Great North Road Underpass, Avondale Heights Tunnel, and the Alan Wood Reserve.

The majority of the SH20 extension will be constructed off-line and require minimal temporary traffic management. Traffic management for the extension will be limited to a section of Great North Road south of the Great North Road Interchange, a section of Richardson Road, and the Maioro Street Interchange.

The site access to the north end of the SH20 extension work site will be established off Great North Road at a temporary signalised intersection as shown on the drawings below. Site access to the south end will be accessed from Richardson Road until works are completed on the Richardson Road Bridge, at which time access will be gained via SH20 at the Maioro Street Interchange. Access to the Sector 8 and 9 works will typically be achieved via internal construction roads connecting to Richardson Road, however a minor site access will be permitted onto Hendon Avenue. However, the residential nature of this street means that trucks will not be permitted to access that site unless under an approved SSTMP and in consultation with local stakeholders and the RCA.

Site access via Maioro Street Interchange will be achieved through a temporary “site entry only” off-ramp from SH20 northbound and a temporary “site exit only” on-ramp to SH20 southbound.

A coordinated approach will be required to mitigate the effects on the wider network surrounding the SH20 extension. The SH20 wide approach will include both travel demand reduction strategies and public advertising campaigns.

The following sub sections describe the mitigation measures for each sector. These measures mostly relate to; temporary reduction in lane capacities, compound site access (arrangement and operation), work zone site access (arrangement and operation), and detour routes for both motorists and pedestrians.

## 14. Sector 7 – Great North Road Underpass

### 14.1 Preliminary Traffic Management Methodology

The construction of the Great North Road Underpass is planned to be constructed under two phases with associated lane realignment and narrowing. Each phase is expected to realign Great North Road by re-marking lanes and installing safety barriers to open up work zones to allow off-line construction. A 30 km/hr speed limit will be implemented throughout the works, with narrowed lanes implemented through the site to maximise the amount of construction zone.

Cowley Street will be removed under the proposed scheme, and the connections of Great North Road to Herdman Street and Oakley Avenue are expected to be closed and traffic diverted south to Alford Street during works.

Initially, Great North Road will be realigned to the south to begin construction of the underpass, followed by a shift to the north to facilitate work on the southern extent of the underpass and the portal for the Avondale Heights Tunnel.

The existing number of lanes on Great North Road will remain operational in the temporary alignment during works; however they will be narrowed to a minimum width of 3.0m and 300mm shoulders (i.e. the distance between the edgeline of the road and the barrier protecting the work site). Work in the live lanes of Great North Road will be conducted during night closures under an approved SSTMP.

Pedestrian and cycle access will be maintained on the western side of Great North Road only, with appropriate diversions over a limited length of approximately 300m to divert pedestrians and cyclists onto the western side at each end of the lane narrowing.

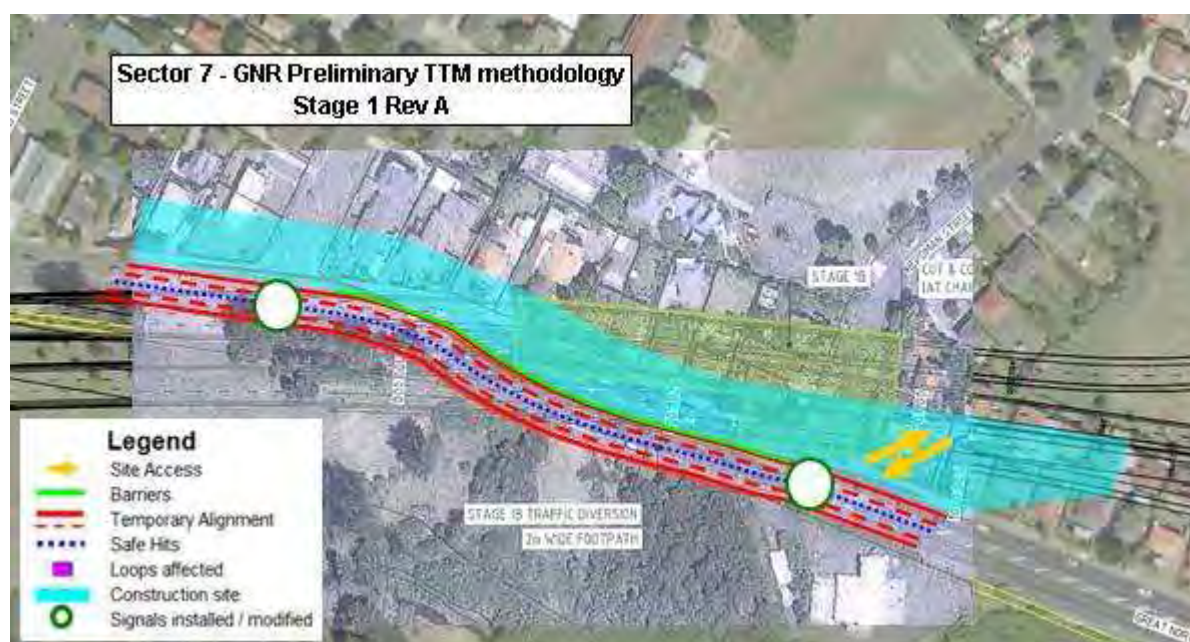
Temporary bus stops will be installed to replace existing bus stops after each realignment of Great North Road. Where necessary, bus stops will be relocated to either end of the site (as agreed with the RCA) with appropriate signage installed to inform bus users of the change in stop location.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic. Site accesses will be provided just to the south of the BP station on the southbound side of Great North Road. This site access may be signalised depending on impact of site access movements on Great North Road.

#### 14.1.1 Stage 1

The construction of the Great North Road Underpass will initially require Great North Road to be narrowed and shifted to the west to allow the construction of temporary pavement to the east of Great North Road. Once the

temporary pavement is complete, traffic will be shifted to the east on to the new temporary pavement. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The construction of pavement at the connections, re-marking of the carriageway and placement of the safety barriers will be installed over a number of nights using lane closures. A schematic of the site layout is shown in **Figure 14-1** below.



**Figure 14-1 - Stage 1 works on Great North Road Underpass**

The connection of Oakley Avenue with Great North Road will be temporarily closed and traffic diverted to the Alford Street intersection with Great North Road.

The Great North Road Underpass construction yard to the west of Great North Road will be accessed from a temporary signalised intersection on Great North Road, which shall be located at either the Herdman Street intersection or immediately to the north. The intersection will be installed over night using lane closures.

Pedestrian and cycle access will be maintained on the western side of Great North Road only. Pedestrians and cyclists will be detoured to the western side of Great North Road at the Alford Street and temporary signalised site access intersections with Great North Road.

#### 14.1.2 Stage 2

The second stage of the Great North Road Underpass will shift Great North Road to the west on to temporary pavement to allow the construction of a cut and cover tunnel. Once the tunnel and final pavement works are complete, Great North Road will be shifted to its final alignment. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The construction of pavement at the connections,

re-marking of the carriageway and placement of the safety barriers will be installed over a number of nights using lane closures. A schematic of the stage 2 site layout is shown in **Figure 14-2** below.

The Great North Road Underpass work zone and construction yard will be accessed from a temporary signalised intersection on Great North Road, at or just north of the Herdman Street intersection. Site vehicles will be permitted to cross Great North Road through the signalised intersection to minimise the number of site movements along Great North Road.

Pedestrian and cycle access will be maintained on the western side of Great North Road only. Pedestrians and cyclists will be detoured to the western side of Great North Road at the Alford Street and temporary signalised site access intersections with Great North Road.



**Figure 14-2 - Stage 2 works on Great North Road Underpass**

## 14.2 Identification and Mitigation of Traffic Effects

### 14.2.1 Impacts arising from the temporary work site

It is expected that impacts arising from the temporary work site will primarily be associated with the installation of temporary signals for site accesses along Great North Road.

Introduction of temporary speed limits, changes to existing traffic signals and presence of a construction site on Great North Road and on SH16 is likely to induce changes in delays across the Great North Road interchange. **Table 7.1** below indicates the predicted effect on travel times.

Table 14.1 – Effect of Temporary Work Site on Great North Road Travel Times

Route	AM (minutes:seconds)			PM (minutes:seconds)		
	Base	Scenario	% Change	Base	Scenario	% Change
<b>Great North Road</b> (Blockhouse Bay Road to Pt Chevalier Road)	06:04	08:37	42%	19:58	15:54	-20%
<b>Great North Road</b> (Pt Chevalier Road to Blockhouse Bay Road)	02:46	03:22	22%	03:26	04:33	33%

The highest travel time impact is anticipated to occur on Great North Road northbound along the route from Blockhouse Bay road to Pt Chevalier Road, which is estimated to result in approximately 2 minutes 33 seconds additional travel time in the AM peak. The operational model indicates smaller increases in the other directions and peak periods, with a decrease shown in the northbound direction in the PM peak.

It is important to note that the changes in travel times noted above are based on a scenario that includes all temporary work sites implemented concurrently along SH16 and Great North Road and therefore the figures quoted above will be a conservative estimate of the effects of the works on the network.

The site access points on Great North Road will be installed and designed as per the RCA requirements for traffic signal design. The signal phasing will be optimised to prioritise Great North Road traffic, and consideration will be given to closure of the site access during peak periods if the site access is shown to impact upon the LOS on Great North Road, or if queues from the signals affect SH16. Further detail of the signal operation and design will be developed as part of the detailed design phase of the Project. The intersection will also be designed in accordance with RCA requirements and consider turning bays for vehicles entering the access and appropriate visibility.

A strategy will be put in place through out construction on Great North Road to reduce the volume of traffic on the Great North Road and advise of alternative routes. An advertising campaign will be launched advising the public of the upcoming work, the expected impact they will have on the network efficiency, and appropriate alternative routes other than Great North Road. An advertising campaign will include the erection of project signs at the approaches to the project, notifying the passing motorists of the upcoming works. Regional and local media will be used to advertise the upcoming works and the alternative route.

The use of New North Road and Carrington Road or St Lukes Road will be suggested as an alternative route to avoid the construction zone. Electronic Variable Message Signs (VMS) will be positioned in the shoulder in advance of work areas and prior to alterations to the road alignment, warning the public and advising of alternatives routes. The alternative route scheme is shown in **Figure 14-3** below.



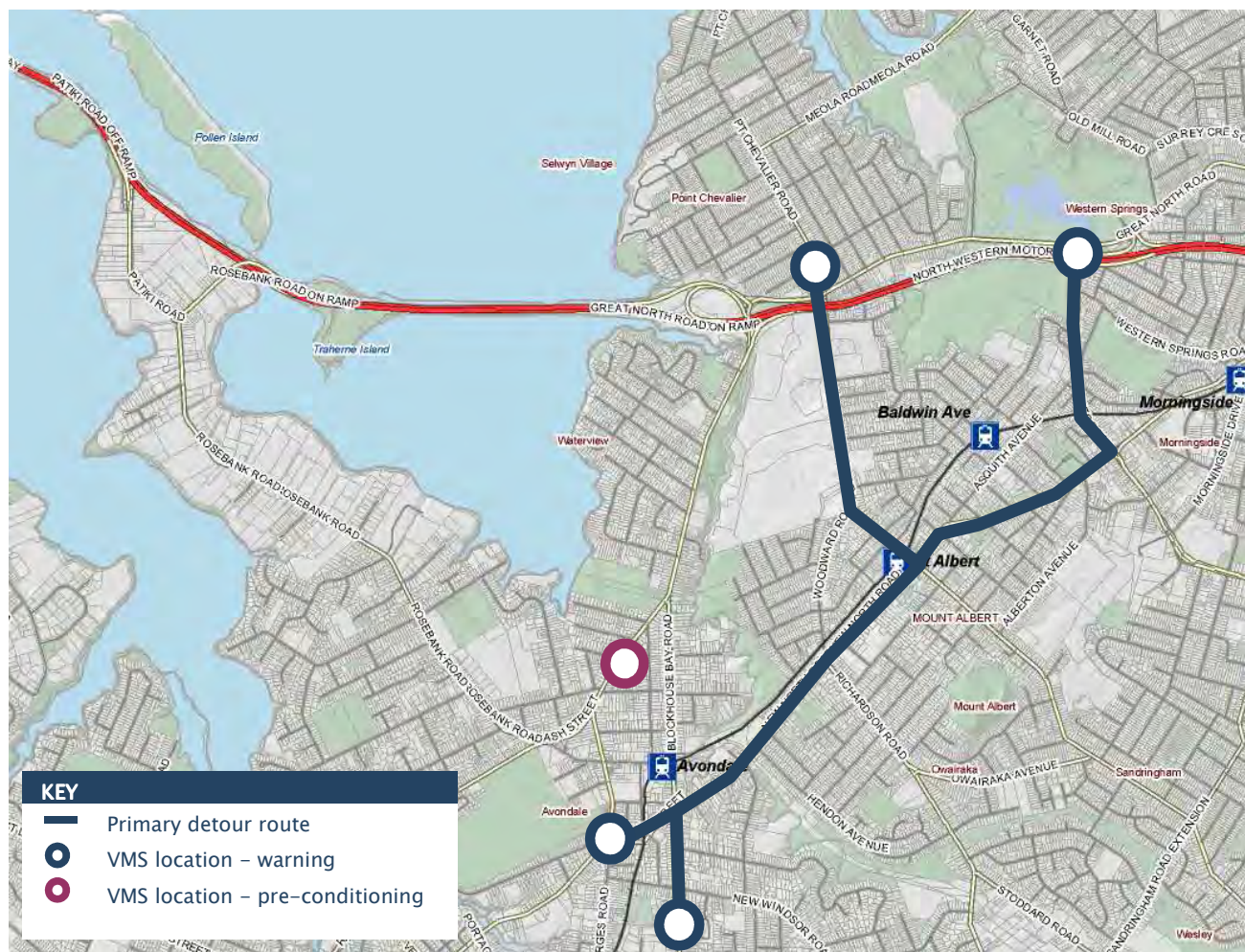


Figure 14-3 – Great North Road alternative routes

#### 14.2.1.1 Oakley Avenue and Herdman Street

During construction of the tunnel it is anticipated there will need to be closures of Oakley Avenue and Herdman Street at the intersections with Great North Road, blocking access directly onto Great North Road. There will not be closures of both at the same time.

During closure of the Oakley Avenue connection with Great North Road, eastbound traffic will be diverted off at the Oakley Avenue and Saxon Street Intersection and directed to the Herdman Street intersection with Great North Road via Daventry Street.

During closure of the Herdman Street connection with Great North Road, traffic will be diverted at the Herdman Street and Daventry Street intersection and directed to the Oakley Street intersection with Great North Road.

These diversions will have a minor impact on the accessibility of Waterview suburb to the west of Great North Road, and will result in a small increase in travel time for road users. However, there are relatively few trips accessing to / from Waterview and as such the impacts to these road users is considered to be less than minor.

Impacts to travel times and accessibility for Waterview will be mitigated where possible, through review of the optimisation of the signals at Alford Street and Herdman Street. Upgrades to the Alford Street or Herdman Street intersections may be considered if there are significant queues or delays observed on the approaches to Great North Road.

During closure of the Herdman Street intersection, installation of temporary signals at the Oakley Avenue intersection with Great North Road will be considered. Implementation of this measure will be dependent on the duration of closures of the Herdman Street intersection and observation of increased queues and delays at the Oakley Avenue and Alford Street intersections. Installation of temporary signals would be considered in accordance with the CTMP and installed under an approved SSTMP.

### 14.2.2 Impacts arising from temporary closures

The construction works on Great North Road may require full closures in very limited circumstances, however at this time it is anticipated that the majority of works will be undertaken under lane closures. Lane closures will be undertaken over night only, and both directions of traffic will be maintained unless alternative methodologies cannot be developed.

It is expected that lane closures would be implemented after 21:00 at night and lifted by 05:30 to minimise impacts on AM peak traffic flows. An assessment of flows on Great North Road will be undertaken in advance of works that require lane closures, and the COPTTM methodology for determining capacity through the work site shall be employed so that delays are minimised.

If full closures are necessary, road users will be advised of the closures at the previous in advance of closed section before and during the closures. Traffic will be directed down the following detour route when the road is closed.

Local diversions for roads approaching Great North Road from Waterview may be necessary depending on the location and nature of works on Great North Road. If this is necessary, advance notice and communications will be provided in accordance with the environmental management plan and the CTMP and a suitable detour provided. Access to Waterview will be maintained at all times via Great North Road in both directions, unless a closure for works is necessary north of Herdman Street in which case access will be maintained to the south along Great North Road.

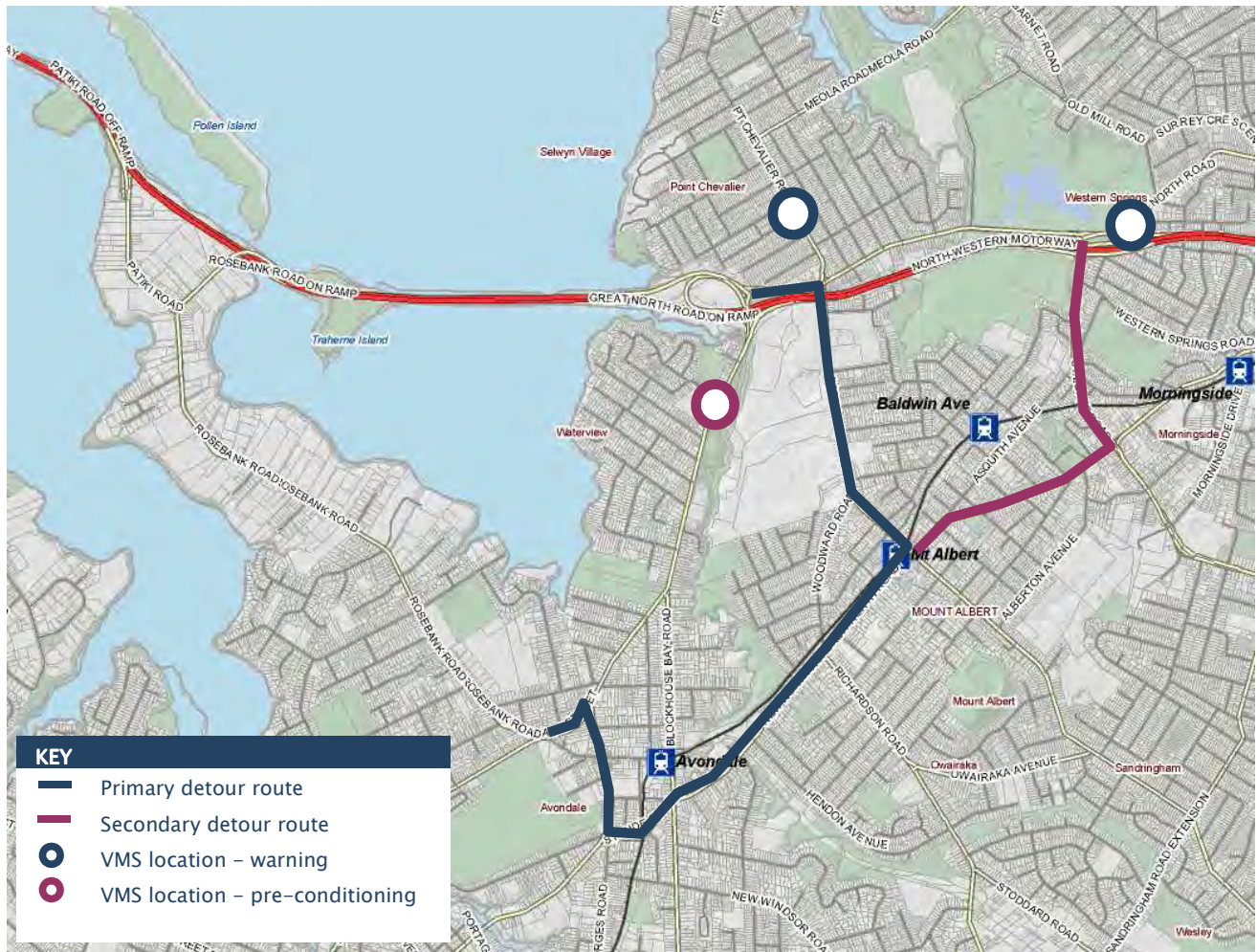
#### 14.2.2.1 Great North Road Detour Routes

All eastbound Off-Ramp traffic will be diverted back to Great North Road via Great North Road, Carrington Road, New North Road and Blockhouse Bay Road.



All southbound traffic on Great North Road will be diverted off at Carrington Road and back to Great North Road via New North Road and Blockhouse Bay Road.

The southbound detours for Great North Road are shown in **Figure 14-4** below.



**Figure 14-4 - Great North Road Southbound Detour Routes**

Due to the length of the detour route, it is recommended that a secondary detour route is recommended at the St Lukes interchange to minimise the number of trips getting onto the motorway with the intention of using the Great North Road Westbound Off-Ramp to access Great North Road.

All northbound traffic on Great North Road, including the Great North Road Interchange Westbound On-Ramp and eastbound loop on-ramp traffic, will be diverted at the Ash Street intersection with Great North Road and New North Road intersection with Blockhouse Bay Road to divert traffic away to the St Lukes Interchange via New North Road and St Lukes Road. A secondary detour route will need to be provided for road users that miss the primary route, and access for residents to the west of Great North Road in Waterview will be provided.



Signage will direct traffic wishing to travel either westbound down SH16, eastbound down SH16, or eastbound down Great North Road. The signals along Blockhouse Bay Road, New North Road and Carrington Road will be optimised to allow the traffic to continue to flow efficiently with the additional demand.



**Figure 14-5 – Great North Road Northbound Detour Routes**

Closure of the northbound direction of Great North Road is difficult to communicate and has very long detour routes as shown. As such, priority will be given to keeping Great North Road northbound open throughout the works and if necessary the northbound traffic will be contra-flowed on the southbound direction and southbound diverted. However, as noted previously, closures of Great North Road are expected to be very limited if at all, and if possible works that require closures will be undertaken under lane closures or stop-go operations.

At this time it is not envisaged that full closures of Great North Road would be required at all, however this cannot be fully ruled out.

Due to the length of the detour routes required, it is desirable to minimise the duration of the closure and to minimise the number of road users that are affected by the closure. As such, extensive pre-conditioning and advertising campaigns could be expected if Great North Road was to be closed during works.

#### 14.2.3 Impacts on pedestrians and cyclists

During the construction activities on Great North Road, there will be some impact on accessibility and convenience for pedestrians and cyclists through the work site. This is because the eastern pedestrian / cycle way will be closed during works, and diversions put in place to divert pedestrians to the western side of Great North Road.

The pedestrian / cycle way will be diverted onto the western side of Great North Road at the signalised intersections to the north and south of the site in order to minimise the safety risks of closing such a busy arterial. A review of the pedestrian provisions at these intersections will be undertaken during development of the SSTMP.

It is acknowledged that diversion of pedestrians and cyclists during works will cause inconvenience and delays. As such, it will be necessary to investigate options for maintaining operational pedestrian / cycle ways on both sides of Great North Road. Before and after monitoring of travel times and volumes of pedestrians and cyclists will be undertaken to determine the effect of the works on the desirability and accessibility through the site, which will inform a mitigation strategy in accordance with the CTMP.

#### 14.2.4 Impacts arising from site access

During works on Great North Road Underpass, there will be site accesses to both the western and eastern sides of Great North Road.

It is anticipated there will be a construction yard to the west of Great North Road just south of SH16, which will require site access throughout works.

In order to provide full movements from the site and to maximise safety for the public and site vehicles, it is anticipated that the site access to the compound to the west of Great North Road will be signal controlled. The existing signals at Herdman Street will be modified to provide for site access movements from the north west of the existing intersection, with an additional phase for site vehicles.

A detailed design of this intersection will be developed and agreed with the RCA prior to implementation on site.

The additional phase at the signalised intersection is expected to generate some additional delay to vehicles passing along Great North Road. The design and operation of the signals will be developed to minimise delay to vehicles on Great North Road, and consideration will be given to closure of the site access during peak periods if significant delays or queues are observed.

Following completion of stage 1 works, a second site access will be needed for access to the part of the site to the east of Great North Road. This access will be provided at either an modified Herdman Street intersection as discussed above, with an additional leg provided for the eastern site, or at a separate site access located further south. At this time, it is not known where the site access to the eastern part of the site will need to be located, however it is anticipated that it will need to be signal controlled and will either supplement the Herdman Street intersection or form a new intersection further to the south.

In either case, a detailed assessment of effects will be undertaken prior to site establishment, and the performance of Great North Road will be prioritised in developing and managing the site access provisions.

### 14.2.5 Impacts on public transport

A number of buses pass through Sector 7 and these services are expected to be affected by the works. This will primarily due to the relocation of bus stops through the site which will be relocated to minimise delays to through traffic arising from the site layout. Bus stops will be relocated to either end of the site to locations that provide a safer route for pedestrians. The bus stop relocations will take into account the closure of the eastern footpath on Great North Road, and the presence of the school on Herdman Street.

Installation of temporary traffic signals at the site accesses can be expected to cause some additional delays along Great North Road and travel times for buses will be affected along with the general stream of traffic.

There are no bus priority measures situated along Great North Road within Sector 7, and as such there are not anticipated to be any travel time impact over and above those experienced by the general stream of traffic.

## 15. Sector 8 – Avondale Heights Tunnel

### 15.1 Preliminary Traffic Management Methodology

The construction of the Avondale Heights Tunnel is expected to require minimal temporary traffic management. Short term traffic management affecting local road lanes or footpaths may be required for supplementary tunnel construction works. Site access to the north end of the work site will be established off Great North Road and at the south end of the work site off Richardson Road. Clear access procedures will be put in place to facilitate the efficient movement of the large number of trucks expected to transport the tunnel construction spoil.

Works on the Avondale Heights Tunnel will be undertaken off line from the road network. Impacts arising from the tunnel construction are expected to be limited to site access movements at the northern and southern end of the site, at Great North Road, Richardson Road and SH20 (via the Maoro Street Interchange).

The location and management of the site access movements at Great North Road are detailed as part of discussions about Sector 7.

Access movements to the south will occur via Richardson Road and SH20. During the first stage of works on Richardson Road Bridge (see Sector 9), access to the Avondale Heights Tunnel site will be via site accesses on Richardson Road. Following completion of the Richardson Road Bridge, the site will be accessed via SH20.

The Richardson Road access will be designed and managed to minimise the effect on the road network, which will be agreed with the RCA in a SSTMP in accordance with the CTMP prior to start of works.

## 16. Sector 9 – Alan Wood Reserve

### 16.1 Preliminary Traffic Management Methodology

The majority of the southern approach to the Avondale Heights Tunnel will be constructed off-line. Site access to the work site will be established off Richardson Road, at the location of the future Richardson Road.

Richardson Road will be temporarily realigned outside of the Richardson Road overbridge footprint to allow the construction of the bridge. Temporary footpaths and localised pedestrian / cycle diversions will be necessary, and Richardson Road bus stops will be relocated to the north and south as appropriate.

With the exception of the Richardson Road Bridge construction, a majority of works on the SH20 extension through Sector 9 will be conducted off-line and will not impact on the existing road network. Impacts arising from the extension are expected to be limited to site access movements at the southern end of the site.

Work on the Richardson Road Bridge will be undertaken over two phases of realignments with lane narrowing and realignment. In the first stages Richardson Road will be realigned to the west to allow completion of the new bridge, and Richardson Road transferred to the new bridge under stage Two. The existing number of lanes on Richardson Road will remain operational throughout works, however they will be narrowed to a minimum width of 3.0m and 300mm shoulders (i.e. the distance between the edgeline of the road and the barrier protecting the work site). Work in the live lanes of Richardson Road will be conducted during night closures under an approved SSTMP.

Pedestrian and cycle access will be maintained on the eastern side of Richardson Road only, with appropriate diversions to divert pedestrians and cyclists onto the western side at each end of the lane narrowing.

Existing bus stops on Richardson Road will likely be relocated away from the extent of the works to minimise the risk to pedestrians and to minimise interaction between buses and construction traffic. It is anticipated that bus stops on the northbound direction will be relocated to the south, and bus stops on the southbound direction will be relocated to the north.

Temporary TL-3 barriers will be installed to isolate the work site from passing traffic with gaps provided where necessary.

The works on the SH20 extension to the north of Richardson Road will be accessed from Richardson Road until works are completed on the Richardson Road Bridge, at which time access will be gained via SH20 at the Maioro Street Interchange. Site access via Maioro Street Interchange will be achieved through a temporary “site entry only” off-ramp from SH20 northbound and a temporary “site exit only” on-ramp to SH20 southbound.

Site accesses to the compound will be designed and managed to minimise the effect on the road network, which will be agreed with the RCA and NZTA's network maintenance consultant in a SSTMP prior to start of works.

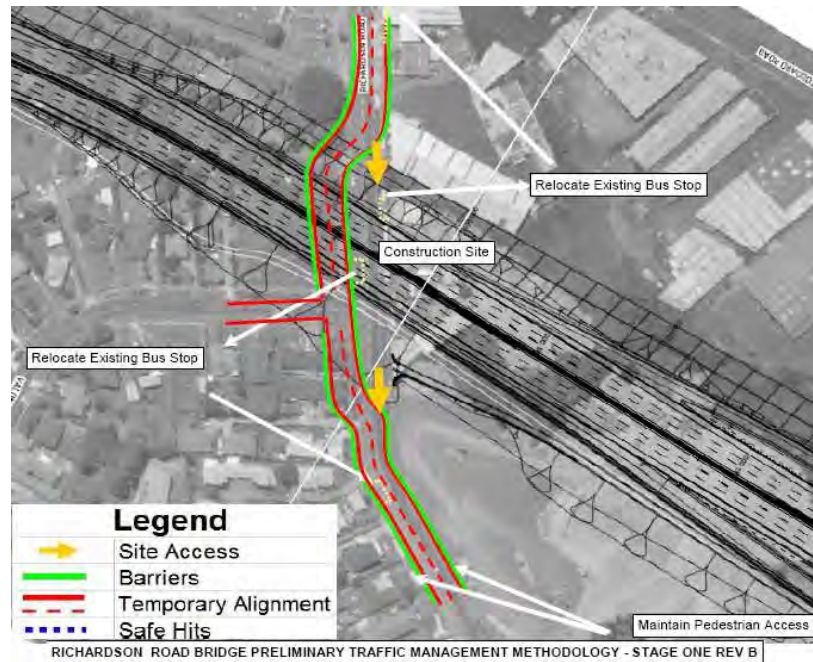
### 16.1.1 Stage 1

The construction of the Richardson Road Bridge will initially require Richardson Road to be narrowed and shifted to the east to allow the construction of temporary pavement to the west of Richardson Road. Once the temporary pavement is complete, traffic will be shifted to the west on to the new temporary pavement. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The construction of pavement at the connections, re-marking of the carriageway and placement of the safety barriers will be installed using lane closures. Valonia Street intersection with Richardson Road will remain open during the Richardson Road Bridge staging.

It is anticipated the main access to the site for the southern portal of the Avondale Heights tunnel will be provided via Richardson Road until such time the Richardson Road Bridge is complete. The Richardson Road Bridge work zone will be accessed from the southbound direction on Richardson Road, in the direction of traffic flow. There will also be a site access provided to the west of Richardson Road, to provide access to Sector 8 works.

Pedestrian access will be maintained on the eastern side of Richardson Road only. Pedestrians will be detoured to the eastern side of Richardson Road at the Stoddard Road and Maioro Street signalised intersections with Richardson Road and at temporary pedestrian refuges either end of the work zone. Pedestrians from Valonia Street will be detoured to the temporary pedestrian refuge at the southern end of the Richardson Road work zone.





**Figure 16-1 - Stage 1 works on Richardson Road Bridge**

### 16.1.2 Stage 2

The second stage of the Richardson Road Bridge will shift Richardson Road back to its original and final alignment. Construction of the SH20 extension will continue either side of Richardson Road. Temporary safety barriers will be installed to separate the carriageway from the construction work zones. The construction of pavement at the connections, re-marking of the carriageway and placement of the safety barriers will be installed using lane closures.

Once the Richardson Road Bridge is completed, access to Sector 8 and 9 will be achieved via the Maioro Street Interchange via formed on and off-ramps at the to-be-completed south facing (half diamond) interchange ramps.

Pedestrian access will be reinstated to both sides of Richardson Road in Stage 2.

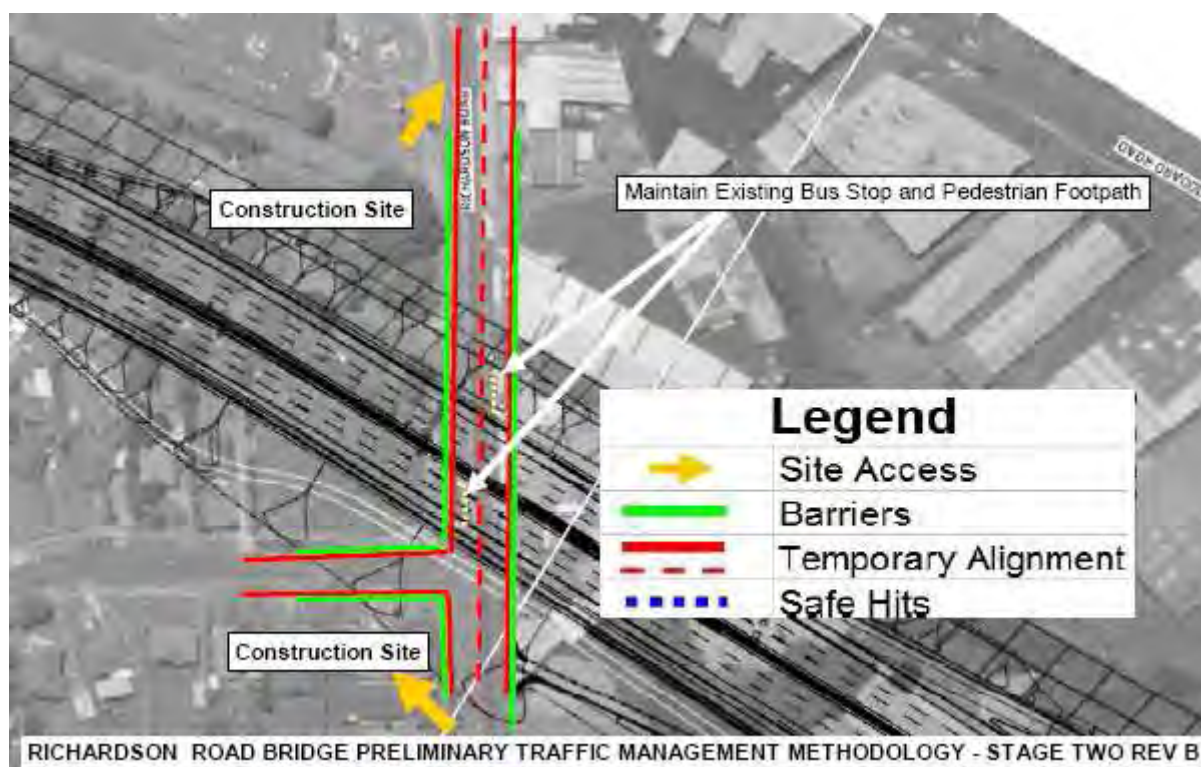


Figure 16-2 – Stage 2 works on Richardson Road Bridge

### 16.1.3 Identification and Mitigation of Traffic Effects

The site access points on Richardson Road will be designed in accordance with RCA requirements and consider appropriate visibility. The access points will be entered and exited in the direction of flow of the adjacent traffic lane to minimise potential conflicts, and if right hand turns are necessary the provision for either signal controlled access or right turn bays will be considered.

A strategy will be put in place through out construction on Richardson Road to reduce the volume of traffic on the Richardson Road and advise of alternative routes. An advertising campaign will be launched advising the public of the upcoming work, the expected impact they will have on the network efficiency, and appropriate alternative routes other than Richardson Road. An advertising campaign will include the erection of project signs at the approaches to the project, notifying the passing motorists of the upcoming works.

Regional and local media will be used to advertise the upcoming works and the alternative route. The use of New North Road or the Maioro Street Interchange will be suggested as an alternative route across SH20. Electronic Variable Message Signs (VMS) will be positioned in the shoulder in advance of work areas and prior to alterations to the road alignment, warning the public and advising of alternatives routes.

#### 16.1.4 Impacts arising from the temporary work site

It is expected that impacts arising from the temporary work site will primarily be associated with the installation of temporary signals for site access if they are necessary. The impacts arising from site access are detailed in section 16.1.7 below.

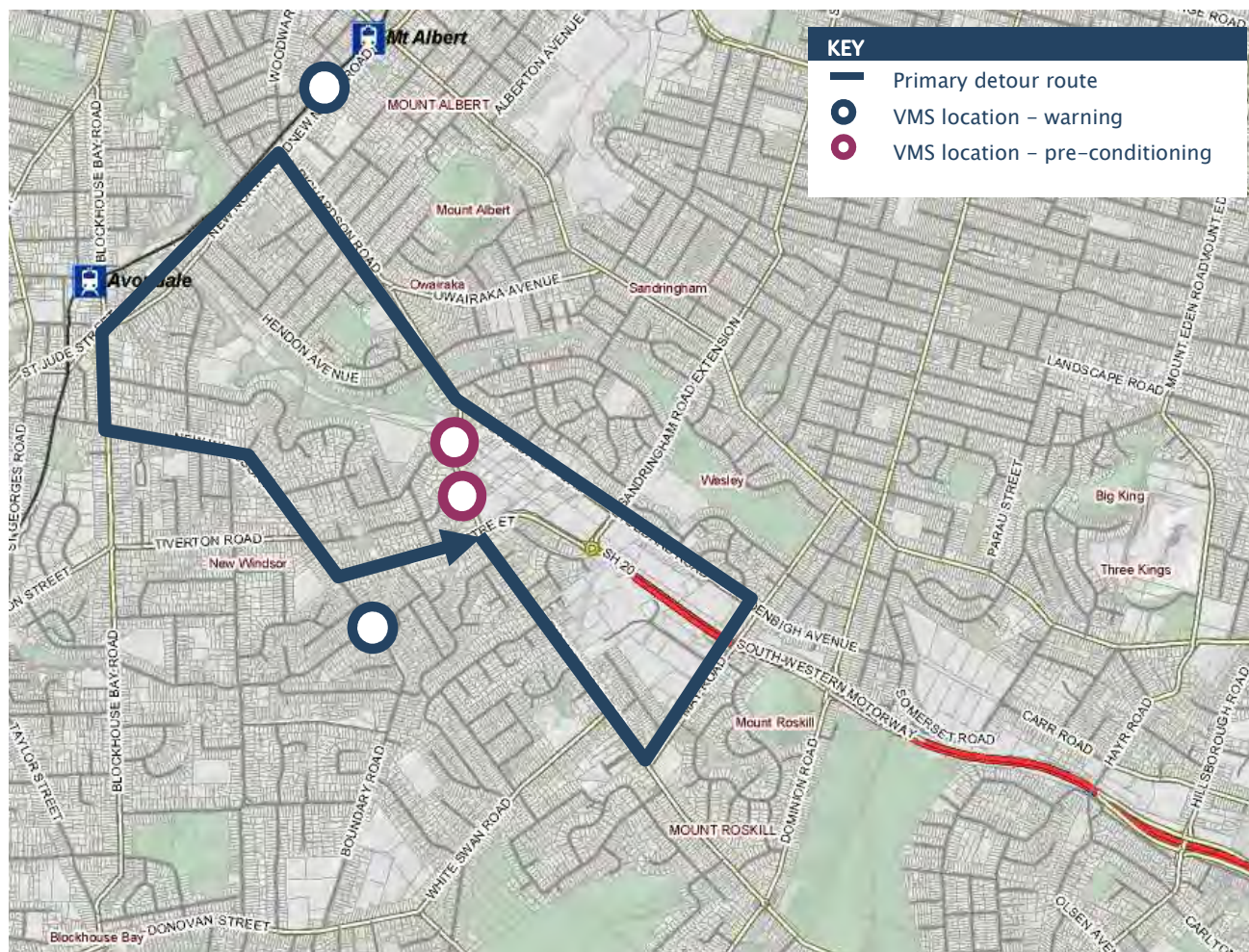
The installation of lane narrowing and a temporary speed limit on Richardson Road is anticipated to have little impact on travel times through the site.

#### 16.1.5 Impacts arising from temporary closures

Temporary closures will be necessary on Richardson Road during bridge construction works and for realignment of the road between each stage of works.

Closures will be programmed to minimise disruption on daytime traffic with closures installed after 8pm and the road re-opened by 6am at the latest. The detour routes for the closure of either direction is shown in **Figure 16-3** below.





**Figure 16-3 – Detour routes for Richardson Road closures**

This figure shows a likely scenario for the detour routes and VMS messaging necessary for closure of Richardson Road. This approach will minimise the number of road users caught on the detour route through pre-conditioning and warning signage on the significant approaches to the affected segment of Richardson Road.

#### 16.1.6 Impacts on pedestrians and cyclists

During the construction activities on Richardson Road, there may be some impact on accessibility and convenience for pedestrians and cyclists through the work site. This is because the existing pedestrian footpaths will be narrowed and diverted around the work sites, and one or the other may be required to be closed during works.

Diversions will be installed to divert pedestrians to the alternative side of Richardson Road. Pedestrian refuges and signage will be installed to provide safe crossing points.

### 16.1.7 Impacts arising from site access

There will be site accesses to both the western and eastern sides of Richardson Road during works on Richardson Road Bridge and the works in the sectors to the east and west of Richardson Road.

As noted previously, it is anticipated the main access to the site for the southern portal of the Avondale Heights tunnel will be provided via Richardson Road, until such time the Richardson Road Bridge will be complete. Once the Richardson Road Bridge is completed, access to Sector 8 and 9 will be achieved via the Maioro Street Interchange via formed on and off-ramps at the to-be-completed south facing (half diamond) interchange ramps.

Site access movements can be anticipated to affect Richardson Road until such time the new bridge is constructed and site traffic is able to access via Maioro Street interchange. The site access movements will be managed to minimise the effect on Richardson Road, and if necessary restrictions will be made on the movements or hours of operation of particular movements of the accesses if necessary. For example, right hand turns may be banned during peak periods if safety concerns are identified or if the movements generate queues or delays.

Consideration will be given to provision of right turn bays or signal controls at the intersection in consultation with the RCA prior to site establishment. A detailed assessment of effects will be undertaken prior to site establishment, and the performance of Richardson Road will be prioritised in developing and managing the site access provisions.

### 16.1.8 Impacts on public transport

A number of buses pass along Richardson Road and these services are expected to be affected by the works. This will primarily be due to the relocation of bus stops through the site which will be relocated to minimise delays to through traffic arising from the site layout. Bus stops will be relocated to either end of the site to locations that provide a safer route for pedestrians. The bus stop relocations will take into account the location of pedestrian attractors / generators in the area.

## 17. Conclusion

This assessment has provided an appraisal of the traffic impacts that are anticipated to arise from the construction of the Project. The traffic management methodology has been developed and impacts identified on the basis of the current understanding of construction methodology.

As such, it is anticipated that the traffic management methodology and understanding of the associated impacts will undergo further refinement through the procurement process and upon involvement of the contractor. To this end, this assessment is largely qualitative and provides a preliminary appraisal upon which preliminary mitigation measures have been developed.

This assessment proposes measures to mitigate the identified impacts. In general it is expected that traffic impacts will primarily be managed in accordance with the Waterview Connection Construction Traffic Management Plan (CTMP), which forms part of the Construction Environmental Management Plan (CEMP) suite of documents.

This assessment identified a number of impacts to SH16 and the arterial road network that will require detailed mitigation strategies at the construction planning stage. It is expected that the effects and mitigation strategies identified in this assessment will be used to inform the traffic management methodologies employed for facilitating construction work on the Project.

In general the effects outlined in this assessment are expected to be able to be mitigated acceptably provided the procedures outlined by the CTMP are followed. The effects are not anticipated to be significantly greater or unusual compared with other major road construction projects completed in the Auckland region in the last five to ten years. As such, the NZTA has considerable experience and a strong track record of successfully managing the effects of construction on traffic that will be carried through onto the Waterview Connection Project.

## APPENDIX A

### WATERVIEW CONNECTION - CONSTRUCTION TRAFFIC MANAGEMENT PLAN