Hexham Straight Widening

Traffic and Transport Assessment

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Transport for NSW

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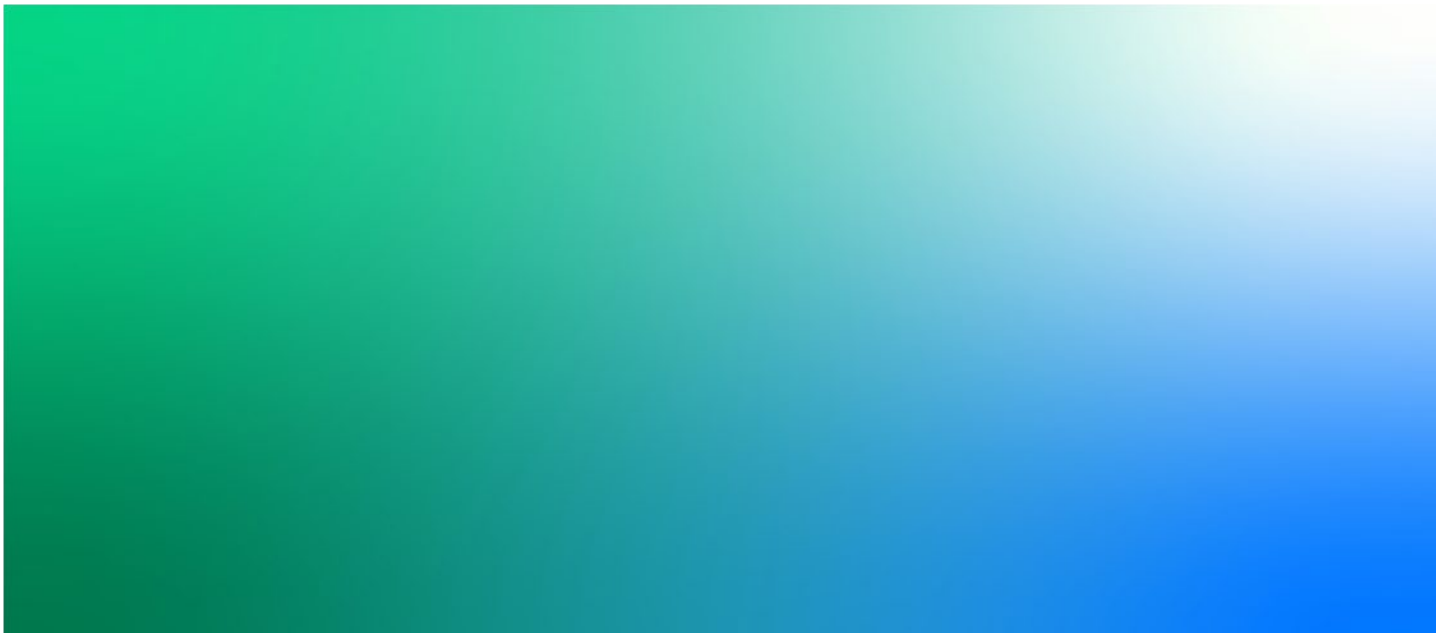

Executive summary

Background

Transport for NSW (Transport) is proposing to widen a six kilometre section of the Pacific Highway (Maitland Road) from four lanes to six lanes, starting about 290 metres south of the intersection with the Newcastle Inner City Bypass at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW (the proposal). The proposal would create two additional lanes, one in each direction and would include the replacement of the twin bridges across Ironbark Creek. The section of road is known as the 'Hexham Straight' and is located within the City of Newcastle local government area (LGA) with a small portion of the construction area within the Port Stephens Council LGA.

Maitland Road is a critical link as part of the National Land Transport Network and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. The proposal is required to reduce congestion and improve safety along Maitland Road.

The proposal is subject to assessment under two planning pathways, a review of environmental factors (REF) under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and an environmental impact statement (EIS) under Part 4 of the EP&A Act. The majority of the proposal (the REF area) is subject to approval under Division 5.1 of the EP&A Act and would be determined through a REF by Transport. However, a small part of the proposal (3.28 hectares) is within land mapped as 'Coastal Wetlands' under State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP). As such, that part of the proposal (known as the EIS area) is subject to approval under Part 4 of the EP&A Act and will be assessed within an EIS.

Purpose

The purpose of this report is to support both the EIS and the REF and to assess the potential impacts on traffic and transport during the construction and operation of the proposal. Secretary's Environment Assessment Requirements (SEARs) relevant to the EIS portion of the assessment (EIS area) include:

- An assessment of safety and access to intersections and properties during construction.

The EIS area does not contain any current operational intersections. Therefore this assessment relates to temporary access for vehicles and equipment to the EIS area to facilitate the demolition of the existing Ironbark Creek Bridge and upgrade of Maitland Road to the north of Milliams Road. This is discussed in the sections below.

Overview of impacts on traffic and transport impacts in the REF area

Transport has carried out extensive traffic modelling for the proposal for the opening year (2028) and future years (2038 and 2048). The construction, operational and cumulative impact of the proposal on traffic and transport have been identified from quantitative performance indicators such as network statistics, level of service and travel time and qualitative assessment. The main impacts are summarised as follows:

- During construction:
  - The staged construction program ensures Maitland Road remains open in both directions during the extent of construction works, minimising disruptions to general traffic, public transport, pedestrian and cyclist, rail and maritime traffic movements
  - Travel time delays for road users arising from a reduction of the posted speed limit and additional vehicle movements to transport materials to site are to be expected

  - Minimal impacts to existing residential and commercial property accesses are expected during construction, although further stakeholder consultation is required to confirm property access requirements.

- During operation:
  - The proposal would provide positive outcomes for the performance of the road network in each of the modelled scenarios across both the morning and evening peak periods. This is demonstrated by the improvements to network statistics such as average speed, delays and vehicle hours travelled
  - The proposal would result in improved outcomes for the road network as the increased capacity would cater to a higher volume of vehicles, while also maintaining faster travelling speeds for motorists
  - The operational performance at the main intersections in the study area shows a generally improved level of service as a result of the proposal
  - The provision of an additional lane and central median with a solid barrier requiring the removal of existing breaks in the median would result in improved safety outcomes for all road users as it would improve traffic flow, remove dangerous merging and U-turn locations resulting in more controlled movements. This is expected to reduce rear end crashes and run-off-road crashes
  - The proposal would minor changes to access and the configuration of three private properties driveways
  - Operational impacts on public and active transport and maritime, rail and freight traffic would be minimal.
- Cumulative impacts:
  - The contribution of the proposal to the cumulative impact on transport and traffic has been considered along with other major projects that are proposed or approved in the area in a high-level qualitative assessment and impacts are considered to be minor.

Overview of traffic and transport impacts in the EIS area

Impacts to traffic and transport in the EIS area are considered minor and include the following:

- During construction:
  - Loss of local access to the EIS area and informal fishing areas including an area of Crown land located to the south east of the Ironbark Creek Bridge and a small informal pullover area on the northern side of the bridge directly opposite to Spark Street
  - The temporary use of access roads in the EIS area during construction by trucks and construction plant to enable road pavement, earthworks (embankment) and construction of piers to support the new bridge over Ironbark Creek
  - The relocation of the bus stop located on Maitland Road opposite Hexham McDonalds
- During operation:
  - The loss of the existing access road in EIS Area 1 located on the south- eastern side of Ironbark Creek. This change in access will potentially impact on the access to a small parcel of Crown land to the north of the proposal work
  - The relocation of the bus stop located on Maitland Road opposite Hexham McDonalds to provide improved pedestrian connectivity.

Management measures

Management measures have been developed to specifically manage potential impact that is predicted as a result of the proposed works during construction and operation. A Traffic Management Plan (TMP) is to be

developed by the contractor prior to construction to confirm haulage routes, site specific traffic controls and traffic impacts. Measures have also been developed to manage access to property and public transport including any bus stops that need relocation. Where possible, the proposal has planned to avoid and minimise traffic and transport impact during the construction and operational phases

Conclusion

The proposal would result in improved traffic performance outcomes across both the morning and evening peaks in 2028, 2038 and 3048. This includes improvements to network-wide speeds, travel times on the Hexham Straight Corridor and intersection level of service. It would deliver improved safety across the network by providing safer roads that reduce the risk of fatal and serious injury crashes.

The proposal would integrate with the existing and planned transport network including rail, pedestrian, cycling and freight infrastructure. It also helps cater to the future demand generated from Tomago and Black Hill regions and ensures improved connectivity for all modes of transport. Overall, this proposal would positively contribute to the transport network in the Hunter region and fulfil the proposal objectives. In addition, the SEAR relating to traffic safety and access in the EIS area will be met through the implementation of the TMP and mitigation measures developed to specifically manage potential impacts identified during construction and operation of the proposal.

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Limitations

The sole purpose of this report and the associated services performed by Jacobs was to provide a preliminary assessment of traffic and transport in accordance with the scope of services set out in the contract between Jacobs and Transport for NSW (the Client). That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the public domain, the Client (if any) and from observations made during the site inspection. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the proposal and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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1. Introduction

1.1 Proposal overview

Transport for NSW (Transport) is proposing to widen a six kilometre section of the Pacific Highway (Maitland Road) from four lanes to six lanes, starting about 290 metres south of the intersection with the Newcastle Inner City Bypass at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW (the proposal). The proposal would create two additional lanes, one in each direction and would include the replacement of the twin bridges across Ironbark Creek. The section of road is known as the 'Hexham Straight' and is located within the City of Newcastle local government area (LGA) with a small portion of the construction area within the Port Stephens Council LGA (refer to **Figure 1.1**).

Maitland Road is a critical link as part of the National Land Transport Network and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. The proposal is required to reduce congestion and improve safety along Maitland Road.

The proposal is subject to assessment under two planning pathways, a review of environmental factors (REF) under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and an environmental impact statement (EIS) under Part 4 of the EP&A Act. The majority of the proposal (the REF area) is subject to approval under Division 5.1 of the EP&A Act that would be determined through a REF by Transport. However, a small part of the proposal (3.28 hectares) is within land mapped as 'Coastal Wetlands' under State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP). As such, that part of the proposal (known as the EIS area) is subject to approval under Part 4 of the EP&A Act and considered within the EIS. This report has been prepared to support both the REF, the EIS and to assess the impacts of the proposal on traffic and transport.

1.1.1 The proposal

The proposal consists of:

- Widening of a six kilometres section of Maitland Road starting about 290 metres to the south of the intersection with the Newcastle Inner City Bypass (A37) at Sandgate and extending to about 760 metres north of Hexham Bridge at Hexham on Maitland Road. The highway would be widened from generally two lanes in each direction to three lanes in each direction
- Replacement of the bridge which spans Ironbark Creek with new twin bridges. The existing bridge and all piers would be demolished, and the outlet of a small drainage channel would be relocated about 10 metres to the east of its existing location
- Minor improvements to nine signalised intersections, including:
  - Newcastle Inner City Bypass and Maitland Road intersection
  - Old Maitland Road, Sandgate to the south of the Calvary St Joseph's Retirement Community at Sandgate and the Maitland Road intersection
  - Northbound U-turn facility and pedestrian facility opposite Calvary St Joseph's Retirement Community at Sandgate
  - Sparke Street and the Maitland Road intersection
  - Shamrock Street and the Maitland Road intersection
  - Old Maitland Road to the south of Hexham Bowling Club and the Maitland Road intersection
  - Old Maitland Road, Hexham to the north of Hexham Railway Station, rail maintenance access road, and the Maitland Road intersection

  - The southbound A1 Pacific Highway exit ramp off Hexham Bridge and the Maitland Road intersection
  - Southern access to the Oak Factory and Maitland Road intersection
- Minor improvements to access roads, unsignalised intersections, entry and exit ramps connecting to the A1 Pacific Highway and the U-turn facility at the northern end of the proposal
- Closure of breaks in the existing median and direct access to two local side roads, one private access road and one U-turn facility
- Provision of a three metre wide shared use path northbound between the Oak Factory and the northern end of the proposal and a new section of off-road shared use path heading east along the Newcastle Inner City Bypass
- Widening of existing footpaths at intersection and bus stops
- Adjustments to property accesses and bus stops
- Provision of U-turn facilities on Sparke Street, Shamrock Street, and Old Maitland Road at Hexham
- Relocation of utilities including power, communications, water, gas and wastewater services
- Modifications and maintenance to existing drainage structures including pits, pipes, headwalls and culverts to suit the road widening and to maintain capacity
- Construction of retaining walls to minimise impacts on nearby properties
- Property acquisition, leases and adjustments
- Construction of hardstand for oversize and overmass (OSOM) vehicle parking at the southern and northern end of the proposal
- Intrusive investigation works such as geotechnical investigations
- Temporary construction facilities, including site compounds and stockpile sites at:
  - One area located in the industrial estate located on Old Maitland Road, Sandgate to the south of Calvary St Joseph's Retirement Community (Compound 1)
  - Two areas located in the industrial estate located to the east of Maitland Road and the west of Old Maitland Road, Hexham extending north from the northern boundary of the Hexham sports field to the area of road corridor underneath the entry ramps to the A1 Pacific Highway and Hexham Bridge (Compound 2)
  - Two areas located in the industrial estate located to the west of Maitland Road, Hexham near the Oak Factory (Compound 3)
  - One area located on vacant land to the east of the U-turn facility at the northern end of the proposal on Maitland Road, Hexham to the west of the main channel of the Hunter River (Compound 4).

An overview of the proposal is shown in **Figure 1.2**. Construction of the proposal would be staged and would take about 30 months to construct.

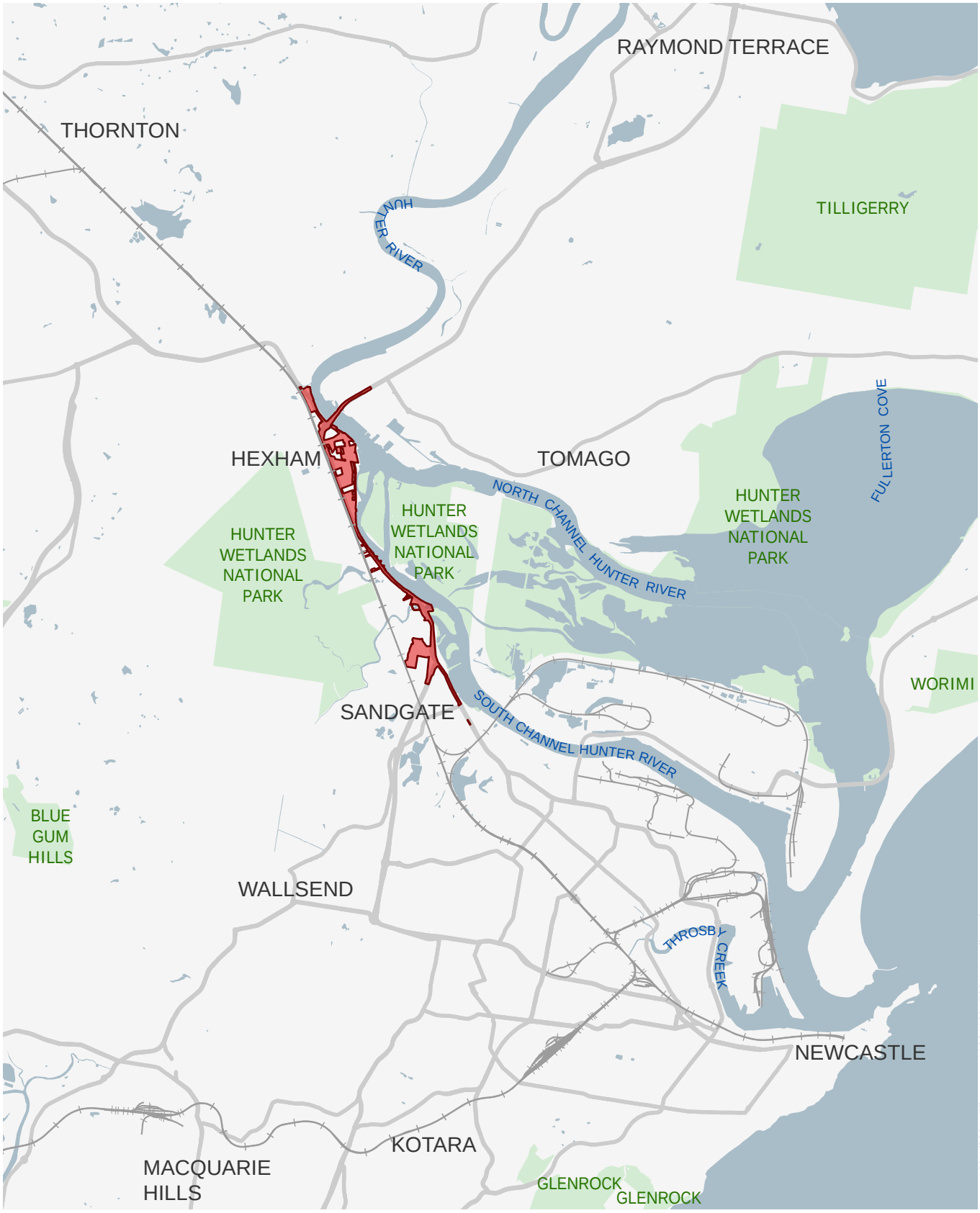
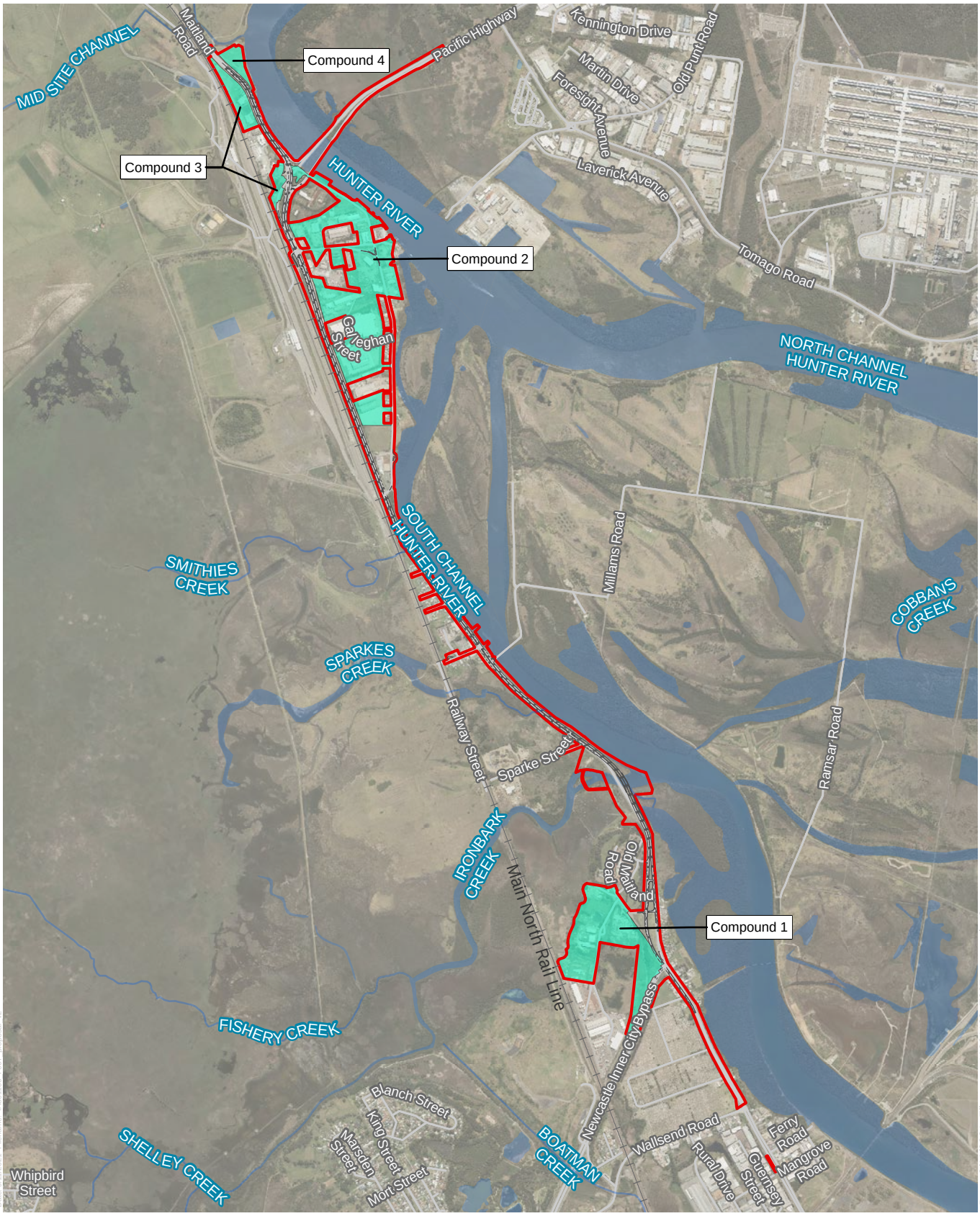


Figure 1.1 Proposal local area

Hexham Straight Widening



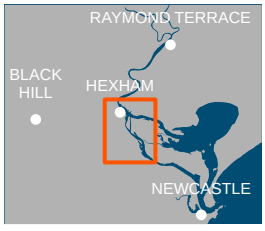
Legend

- The proposal
- Construction area
- Construction compound
- Waterway
- Road
- Railway

0 200 400 m

Scale 1:30,000 at A4

GDA94 MGA56



Data sources:

Jacobs 2020

Department Finance, Services and Innovation 2020

Figure 1.2 The proposal

Hexham Straight Widening

1.1.2 The EIS area

The EIS area assess impacts of the proposal within land subject to the CM SEPP which are shown in **Figure 1.3** and which are at the following three locations:

- EIS Area 1 – a small area located to the south of Ironbark Creek on the eastern side of Maitland Road and to the west of a parcel of Crown land and a section of Hunter Wetlands National Park. The land mapped as Coastal Wetlands includes areas of remnant mangrove and saltmarsh vegetation and also crosses sections of an existing track that provides access to the south bank of Ironbark Creek and to the base of Ironbark Creek Bridge. Access tracks would be required during construction and the permanent work required for the proposal in this area is comprised of road pavement, earthworks (embankment), construction of piers to support the new bridge over Ironbark Creek and the relocation of an unnamed drainage channel to the southeast of the existing bridge
- EIS Area 2 – a small area located to the north of Ironbark Creek on the eastern side of Maitland Road. The land mapped as Coastal Wetlands includes areas of remnant mangrove, saltmarsh and freshwater wetland vegetation. Access tracks would be required during construction and the permanent work required for the proposal in this area is comprised of road pavement, earthworks (embankment) and construction of piers to support the new bridge over Ironbark Creek
- EIS Area 3 – a small area located on the west bank of the south channel of Hunter River to the east of Maitland Road and to the northwest of Millams Road and the Ash Island Bridge. The land mapped as Coastal Wetlands includes areas of the road shoulder and remnant mangrove vegetation. The permanent work required for the proposal in this area is comprised of road widening work to include a third lane in the eastbound direction, as well as a new road shoulder, batter and upgrades to drainage.

There is potential to indirectly impact other areas mapped as Coastal Wetlands from the proposal and where this occurs the impacts have been assessed within this report. The EIS area would be constructed and operated together with the REF area, which has been assessed in the REF prepared by Transport.

1.1.3 The REF area

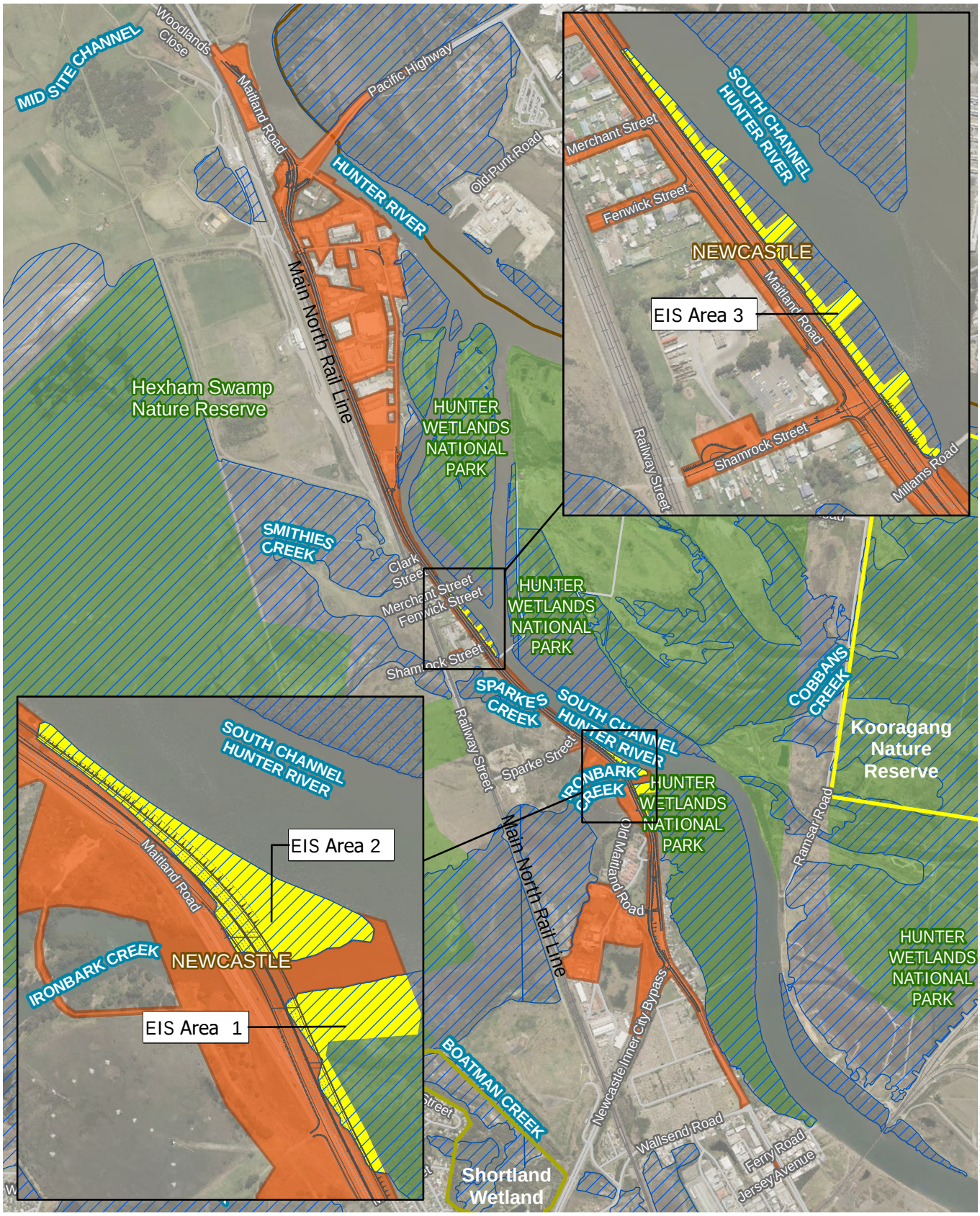
The REF area assesses all other aspects of the proposal included in **Section 1.1.1** that are outside the footprint of the EIS area described in **Section 1.1.2** and shown in **Figure 1.3**.

1.1.4 Relationship of the REF and EIS

Detailed discussion of the planning approval framework and consent requirements is provided in the REF and the EIS. In summary, development consent under Part 4 is usually not required for development for the purposes of a road being undertaken by Transport as a public authority. Rather, this development is ordinarily assessed as an 'activity' under Part 5 of the EP&A Act.

However, on those parts of the land which are identified as coastal wetland under the CM SEPP, the development is classified as designated development and requires consent from the City of Newcastle under Part 4 of the EP&A Act. The part of the proposal located within the Coastal Wetlands is therefore assessed under Part 4 of the EP&A Act. An EIS is required to assess the impacts of any works located within the Coastal Wetlands or any impacts on a Coastal Wetland.

A separate REF has been prepared in accordance with Division 5.1 of the EP&A Act to assess the areas of the proposal located within the REF area. The REF would be determined by Transport. The proposal within the EIS area would be constructed and operated together with the proposal within the REF area. Together, the EIS and the REF assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other. The cumulative impacts of the proposal are located in **Section 5.5**.



Legend

- The proposal
- EIS area
- REF area
- Railway
- Road
- LGA
- Coastal Wetlands
- Kooragang Nature Reserve
- Shortland Wetland
- National Park

0 400 800 m

Scale 1:30,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Date: 9/11/2021 Filename: IA301100_F008_EIS&REF_v3

Figure 1.3 EIS area and REF area

1.1.5 Location

The proposal is located about 10 kilometres north of the City of Newcastle in the suburbs of Sandgate and Hexham. To the east and in some locations next to the proposal is the Hunter River and the South Channel of the Hunter River and the proposal crosses Ironbark Creek. The major freight rail line into the Port of Newcastle uses the Main North Rail Line and this is located west of the proposal and in some locations immediately next to the proposal. The Hunter Wetlands National Park is located both to the east and west of the proposal and the area to the west is also known as Hexham Swamp Nature Reserve. Much of the low-lying national park estate as well as some other low-lying swamp areas including the larger back barrier Hexham Swamp areas are identified as Coastal Wetlands under the CM SEPP. These low-lying areas connect to two areas of Ramsar listed wetlands identified as the Hunter Estuary Wetlands that includes Kooragang Nature Reserve about one kilometre to the east and Shortland Wetlands (including Hunter Wetlands Centre Australia) about 800 metres to the west of the proposal.

The land use along the proposal is characterised by a mix of transport corridors (road and rail), environmental areas including wetlands and waterways, recreational areas both public and private, residential areas and light and heavy industrial areas. The main features of the proposal area and its surrounds include:

- Sandgate Cemetery
- Calvary St Joseph's Retirement Community
- Hexham Bowling Club
- Hexham Park and Cricket Grounds
- Hexham Railway Station
- Residential properties which are located on both sides of Maitland Road to the south of the Calvary St Joseph's Retirement Community, to the west of the proposal along Shamrock Street, Fenwick Street, Merchant Street and Clark Street and along Old Maitland Road behind the industrial estate at Hexham
- Industrial and commercial properties which are located to the north of the Newcastle Inner City Bypass, off Sparke Road at Sandgate and at the northern end of the proposal to the east and north of the Hexham Railway Station.

1.2 Purpose and scope of the report

The purpose of this report is to assess the potential impacts to traffic and transport from constructing and operating the proposal. The report:

- Addresses the relevant SEARs listed in **Table 1.1**
- Describes the existing environment with respect to traffic and transport
- Assesses the impacts of constructing and operating the proposal on traffic and transport
- Recommends measures to mitigate and manage the impacts identified.

The EIS area does not contain any current operational intersections. Therefore this assessment relates to temporary access for vehicles and equipment to the EIS area to facilitate the demolition of the existing Ironbark Creek Bridge and upgrade of Maitland Road to the north of Milliams Road. This is discussed in the sections below.

The methodology for the assessment is described in **Section 3**.

Table 1.1 SEARs relevant to the assessment

SEAR number	Requirements	Where addressed in this report
2.7b	▪ An assessment of safety and access to intersections and properties during construction	An assessment of the safety and access to intersections and properties during construction is included in **Section 5.1**.

1.3 Terms and definitions

The following terms are used in this report:

- Proposal - the widening of a six kilometre section of the Maitland Road from four lanes to six lanes, starting about 290 metres south of the intersection with the Newcastle Inner City Bypass at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW
- Construction area - the area to be directly impacted by the proposal. This comprises the future construction footprint of the proposed bridge over Ironbark Creek and the upgrade of Maitland Road, including all roadside cut and fill, construction compound areas and parking areas for oversize and overmass vehicles, refer further to **Section 1.1.1**
- Study area - the construction area and additional areas that are likely to be affected by the proposal, either directly or indirectly
- EIS area - the areas of the proposal to be assessed under the EIS within land subject to the CM SEPP as defined in **Section 1.1.2**
- REF area - the areas of the proposal to be assessed by the REF and this covers all other aspects of the proposal included in **Section 1.1.1** that are outside the footprint of the EIS area described in **Section 1.1.2**
- Proposal local area - the area within 10 kilometres of the proposal.

2. Legislative framework

2.1 Alignment with transport policies and plans

The proposal is referred to or supports the following strategic plans:

- *Future Transport Strategy 2056* (NSW Government, 2018a)
- *Greater Newcastle Future Transport Plan* (Transport for NSW, 2018a)
- *Moving More with Less 2018* (NSW Government, 2018b)
- *Hunter Regional Plan 2036* (NSW Government, 2016)
- *Road Safety Plan 2021* (Transport for NSW, 2018b)
- *Outer Newcastle Study* (SMEC, 2019).

Further details on each of these strategic plans are provided in the following sections.

2.1.1 Future Transport Strategy 2056

Future Transport Strategy 2056 (Future Transport Strategy) (NSW Government, 2018a) is a 40-year strategy for mobility for regional NSW and Greater Sydney. It sets out a vision, strategic directions and customer outcomes with a focus on technology and innovation across the transport system to transform the customer experience, improve communities and boost economic performance.

The Future Transport Strategy establishes a framework to guide investment in future transport solutions and includes consideration of:

- Greater connectivity to increase transport opportunities
- Multimodal interchanges providing connections to local services
- Safe, efficient and reliable transport networks
- Innovative, flexible and demand-responsive services.

The Future Transport Strategy recognises that the future success of the transport network in the Hunter region is to support infrastructure developments that provide efficient transport connections to, from and within the region. This proposal would aid in meeting the following customer outcomes:

- Customer Outcome 3: Sustaining and enhancing the liveability of our places. The appropriate movement and place balance is established enabling people and goods to move efficiently through the network while ensuring local access and vibrant places
- Customer Outcome 5: Connecting people and places in the growing city. Changes in land use, population and demand, including seasonal changes, are served by the transport system.

2.1.2 Greater Newcastle Future Transport Plan

The *Greater Newcastle Future Transport Plan* (Transport for NSW, 2018c) is a supporting study to the *Future Transport Strategy* (NSW Government, 2018a) and provides an overarching vision for the transport network that will guide future transport planning for the Greater Newcastle area.

Some of the key objectives outlined in the *Greater Newcastle Future Transport Plan* include:

- Development of an integrated public transport network hierarchy
- Further development of active transport networks
- Addressing pinch points in the road network and informing the program of road network optimisation improvements.

The proposal would help achieve the goals of the *Greater Newcastle Future Transport Plan* by addressing pinch points in the road network and delivering improved connectivity to jobs, services and recreation activities.

2.1.3 Moving More with Less, 2018

Moving More with Less (NSW Government, 2018b) is a supporting policy framework established to support the *NSW Freight and Ports Plan 2018 - 2023* (NSW Government, 2018c). The framework outlines the strategic approach for implementing higher productivity vehicles on the road network and identifies the necessary network upgrades required. *Moving More with Less* states that it is desired to have the state-wide freight network gazetted as of right access (Notice) to PBS 2B vehicles within the next 5-10 years (2023-2028). The proposal would improve capacity to the freight network and improve travel times by addressing pinch points in the road network.

2.1.4 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (NSW Government, 2016) identified the need to ensure the efficient movement of freight within the Hunter region. Key transport challenges identified in the plan which are relevant to the proposal include:

- Accessibility to regional facilities, such as education, health, jobs and Newcastle Airport
- Road congestion and safety
- Freight capacity constraints on the road and rail networks
- Impact of freight transport on towns
- Improving connections between smaller towns to regional centres.

This proposal aligns with Direction 4: Enhance inter-regional linkages to support economic growth. Such improvements to transport corridors will be needed to maintain efficiencies in the network, particularly for freight, and to allow for future growth.

2.1.5 Road Safety Plan 2021

Road Safety Plan 2021 (Transport for NSW, 2018b) (Road Safety Plan) was first developed in 2012 with the objective of reducing road trauma in NSW. The plan outlines the State Priority Target and brings together proven strategies to prevent and reduce the impact of crashes and reflects the internationally recognised Safe System approach to improving road safety

The Road Safety Plan outlines the following key priorities:

- Reduce road fatalities by at least 30 per cent from 2008–2010 levels by 2021
- An aspirational target of zero fatalities and serious injuries on NSW roads by 2056.

The proposal would improve safety on the network helping to achieve the goals laid out in the Road Safety Plan.

2.1.6 Outer Newcastle Study

The *Outer Newcastle Study* (ONS) (SMEC, 2019) was commissioned by Transport to inform the prioritisation of future state road upgrades in the study area. The study comprised of traffic assessments, strategic project design, preliminary environmental investigations, cost estimates and an economic assessment of ten projects and eleven project combinations, to determine the most appropriate projects that should be further developed.

Traffic modelling was undertaken in the ONS by Transport (formally Roads and Maritime Services) using a combination of the following models:

- Strategic transport modelling was undertaken using outputs from the Sydney Traffic Forecasting Model. Sydney Traffic Forecasting Model is developed and operated by Transport. It provides a platform to understand changes in future weekday traffic patterns under different land use, transport infrastructure and pricing scenarios
- Microsimulation modelling was undertaken in PTV VISSIM to evaluate network performance of total forecast demand and determine the need for demand capping. VISSIM demand was capped to realistic future traffic growth.

The traffic modelling undertaken throughout the ONS has been built upon for this assessment. Details on the ONS modelling can be found in **Attachment A.**

3. Methodology for the assessment

3.1 Overview of assessment methodology

This report includes an evaluation of the construction and operational impacts arising from the proposal within the proposal area and includes consideration of the surrounding road network. Assessment of the transport and traffic impact of the proposal includes consideration of the following aspects of the transport network both during construction and operation:

- Review of the existing environment:
  - The existing traffic and transport network and activity in the study area was principally assessed through a suite of traffic surveys
  - Analysis of crash data for the study area for the most recent five-year period
- Traffic model development:
  - Forecasts for population and employment growth and inter-regional traffic growth for future years 2028 (the proposal opening year), 2038 (10 years after opening) and 2048 (20 years after opening) to develop future trip matrices
  - Develop future 'do minimum' traffic models at opening (2028) and in future years (2038 and 2048), by developing a microsimulation traffic model which includes other network enhancements unrelated to the proposals that are already committed too or recognised as likely to be committed to
  - Develop future traffic models at opening (2028) and in future years (2038 and 2048), by developing a microsimulation traffic model which includes the proposal
- Identification of construction impact:
  - Construction staging, compound locations and associated construction traffic impact were assessed through a spreadsheet analysis
  - Impact on pedestrians, cyclists and local access during construction were assessed qualitatively
- Assessment of operational benefits and impact:
  - Traffic modelling was used to assess the broad operational traffic benefits of the proposal
  - Impact on transport services by mode and local access was assessed both quantitively from the traffic modelling outputs and qualitatively
- Assessment of cumulative impact as a result of the construction and operation activities of the proposal:
  - Based on the most current and publicly available information, a qualitative assessment was undertaken on approved and proposed projects in the study area.

3.2 Study area

The study area is shown in **Figure 3.1**. The proposal is located within the Hunter region on the western outskirts of the City of Newcastle LGA with a small portion of the construction area within the Port Stephens Council LGA. The study area for the transport and traffic assessment includes:

- A six kilometre section of Maitland Road starting about 290 metres to the south of the intersection with the Newcastle Inner City Bypass at Sandgate and extending about 760 metres north of Hexham Bridge at Hexham on the Maitland Road
- The nine intersections listed in **Section 1.1.1**

Legend

- Traffic and transport study area
- Traffic model boundary
- Waterway
- Railway
- Road

0 1 2 km

Scale 1:50,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 3.1 Traffic study area and traffic model boundary

- Residential properties with accesses located along the proposal on Maitland Road in Sandgate and in Hexham
- The light industrial, heavy industrial and commercial areas located along the proposal in Hexham.

3.3 Modelling methodology

Traffic modelling is a fundamental component of the methodology, the objective of the traffic modelling process is to make the best use of the available transport and traffic data, including existing transport models, to estimate the base and future conditions on the transport network surrounding the proposal. These transport conditions are used to quantitatively assess the operational performance of the network based on scenarios with and without the proposed project.

Microsimulation models are dynamic, stochastic, discrete-time modelling techniques that simulate the movement of individual vehicles based on car-following, lane changing and gap acceptance algorithms that are updated several times every second. These vehicle-to-vehicle interactions provide the basis for calculating delays, queues and travel times.

The modelling for the proposal was undertaken by using the pre-existing VISSIM microsimulation model developed as part of the ONS and M1 Motorway Extension to Raymond Terrace project. The Hexham Straight model pivots off the pre-existing model to ensure the scenarios run are specific to the proposal. **Figure 3.2** gives an overview of the traffic model development process and how the model has been used throughout each phase of its development.

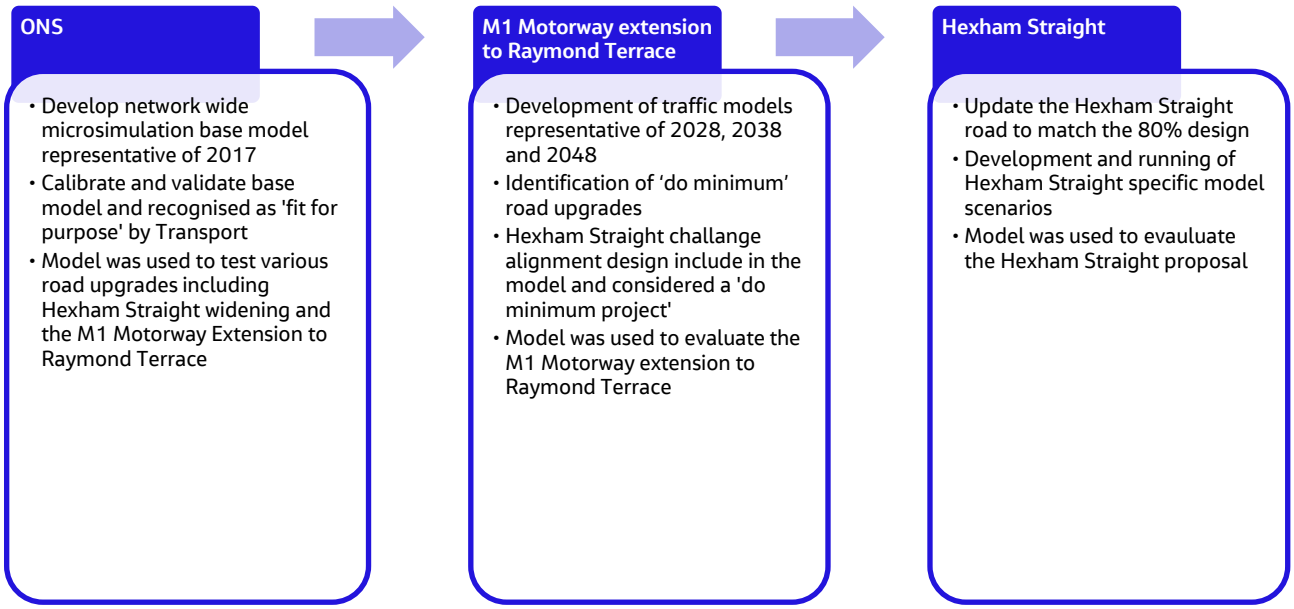


Figure 3.2 Microsimulation traffic model development process

3.3.1 Modelled Area

The VISSIM microsimulation model developed as part of the ONS and M1 Pacific Motorway extension to Raymond Terrace project has been used as the foundation for traffic modelling analysis for this proposal, therefore the model area is larger than the study area. While this assessment will primarily focus on Hexham Straight, the impact of the proposal on the wider network will also be captured. A plot of the modelled area is shown in **Figure 3.3.**

3.3.2 Future traffic demand forecast

To determine a reasonable growth rate for traffic passing through the study area, forecasting of traffic growth was undertaken on a first-principles basis by relating growth in population and employment to traffic growth in the study area. The focus of this method is to develop sensible traffic growth rates for each major road leading into the study area.

Given the limitation in conducting new traffic counts, the growth assumptions developed as part of the ONS were carried forward to develop future models as part of this assessment. The capped growth rates from the ONS were comparable to historic traffic volumes extracted from the Transport's online traffic profile viewer as discussed in **Section 4.1.3. Table 3.1** displays the growth rate assumptions and trips generated from a major private development at Black Hill (Black Hill development) used to develop the traffic demand matrices for the modelled years. Assumptions surrounding the Black Hill Development rate are solely made for the purpose of traffic modelling and do not necessarily reflect a known construction program.

The growth rates for the morning and evening peaks were used to determine the 2028, 2038 and 2048 'do minimum' models from the ONS 2017 model's base trip matrices.

Table 3.1 Traffic growth rate assumptions

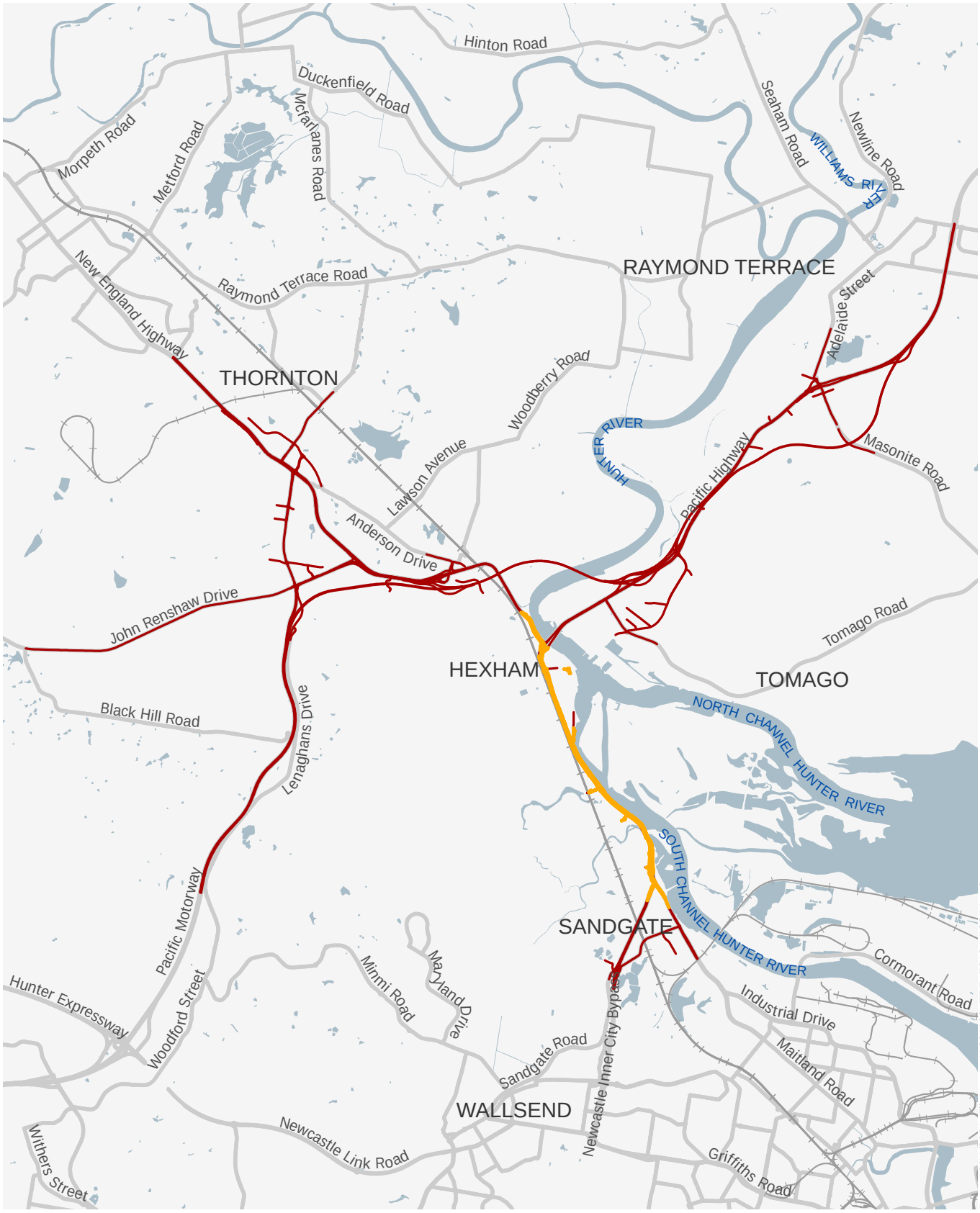
Modelled year	Background growth (both peaks)	Black Hill development
2017 (base)	N/A	0% of development complete
2028 (opening year)	1.5%	25% of development complete
2038 (future horizon)	1.5%	75% of development complete
2048 (future horizon)	1.5%	100% of development complete

3.3.3 Modelling assumptions

The following outlines the parameters and assumptions which influenced the traffic modelling and traffic assessment:

- The year of opening of the proposal is assumed to be 2028
- The proposal was assessed for 10 year (2038) and 20 years (2048) post opening
- The proposed 80 per cent concept design was used for the development of the VISSIM models
- The M1 Pacific Motorway extension to Raymond Terrace was considered a 'do minimum' project and its 80 per cent concept design was used for the development of the 'do minimum' VISSIM Model.

Do minimum projects are network enhancements unrelated to the proposal that are already committed, recognised as likely to be committed or required to ensure a functioning future road network for modelling purposes. The 'do minimum' projects identified for the modelled area are outlined in **Table 3.2.**



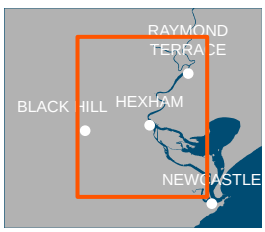
Legend

- The project
- Base model
- Railway
- Road
- Waterway

0 1 2 km

Scale 1:100,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 3.3 Modelled VISSIM area

Table 3.2 Summary of 'do minimum' project upgrades

Do Minimum Upgrade	Modelled years		
	2028	2038	2048
A1 Pacific Highway and Maitland Road intersection upgrade	✓	✓	✓
Maitland Road upgrade	×	✓	✓
Weakleys Drive upgrades	×	✓	✓
John Renshaw Drive and Weakleys Drive intersection upgrade	✓	✓	✓
Duplication of John Renshaw Drive	✓	✓	✓
Freeway Ramp signals on Anderson Drive	×	✓	✓
M1 Pacific Motorway extension to Raymond Terrace	✓	✓	✓
Removal of roundabouts at the Thornton Road and Glenwood Drive intersection and the Weakleys Drive and Glenwood Drive intersection[1]	×	✓	✓

[1]This Do Minimum project was implemented for modelling purposes only. It is not considered a committed or required project for the future

3.3.4 Modelled scenarios

To assess the performance of the road network with and without the proposal and identify the impact of the proposal, traffic modelling of the following scenarios presented in **Table 3.3** was carried out.

Table 3.3 Summary of scenarios modelled

Scenario Name	Year	Hexham Straight	Do Minimum projects	Description
Base	2017	N	N	Reflects the transport network as it was in 2017 with no new projects or upgrades. The year 2017 was adopted as the existing year, as traffic counts were carried out at this time. Calibration and validation was undertaken on the base model also ensures the model is representative of real-world conditions
Do Minimum	2028	N	Y	These include the proposals specified in **Table 3.2** and provides a model for comparative purposes
Do Minimum	2038	N	Y	
Do Minimum	2048	N	Y	
With proposal	2028	Y	Y	These include the proposals specified in **Table 3.2** and the proposal and are compared against the future year 'do minimum' models to determine the impact of the proposal.
With proposal	2038	Y	Y	
With proposal	2048	Y	Y	

3.4 Relevant guidelines

The following guidelines were followed in completing this transport and traffic impact assessment:

- *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (Austroads, 2017)
- *Motorway design guide: Capacity and flow analysis* (Roads and Maritime, 2017)
- *Highway Capacity Manual 2016* (Transportation Research Board, 2016)
- *Traffic Modelling Guidelines* (Roads and Maritime, 2013)
- *Guide to Traffic Generating Developments Version 2.2* (Roads and Traffic Authority, 2002).

3.5 Assessment criteria

The operation of the modelled road network provides an overview of the performance of the road network and is used to identify the impact of the proposal. This impact can be seen either across the network or at individual locations (i.e. an intersection).

The performance of operational traffic is assessed in several ways, including:

- At a network level – This includes average speed, total distance travelled, and total time travelled within the modelled network
- At a single point – At an intersection level, which is calculated from the average delay for vehicles.

3.5.1 Network performance criteria

Road network performance can be assessed with network-wide statistics. These statistics are extracted from the VISSIM traffic for the morning and evening peak periods and the statistics used in this assessment are defined as follows:

- Total throughput – The number of vehicles that complete their trip through the study area within the modelled periods
- Total vehicle hours travelled in the study area (VHT)
- Total vehicle kilometres travelled across the study area (VKT)
- Average network travel speed – which is the average speed (kilometres per hour) of vehicles in the study area during the modelled periods
- Total stops – which is the cumulative total of every instance when a vehicle comes to a stop within the network. A stop is defined as a vehicle's speed dropping below five kilometres per hour until it accelerates to above ten kilometres per hour
- Latent demand – which is the total number of vehicles that cannot enter the model due to model constraints such as congestion.

The above statistics are used to compare the performance of each modelled scenario across the assessment periods and horizon years. These stats are recorded for the entire modelled area which is greater than the study area. Therefore, network performance indicators in isolation can be misleading and they need to be considered in the context of network with other performance indicators.

3.5.2 Intersection level of service

The performance of an intersection and its level of service (LoS) is determined by the average delay per vehicle (d). The performance criteria for intersections is shown in **Table 3.4.**

Table 3.4 LoS criteria for intersections

LoS	Average delay per vehicle (d) in seconds	
	Unsignalised intersections	**Signalised intersections**
A	d ≤ 10	d ≤10
B	10 < d ≤ 15	10 < d ≤ 20
C	15 < d ≤ 25	20 < d ≤ 35
D	25 < d ≤ 35	35 < d ≤ 55
E	35 < d ≤ 50	55 < d ≤ 80
F	50 < d	80 < d

Source: Austroads, Guide to Traffic Management Part 3: Traffic Studies and Analysis, *2017*

3.5.3 Level of Service performance targets

LoS D is the target performance level generally accepted and if the performance of an intersection, interchange or midblock segment falls below LoS D, investigations should be initiated to determine if suitable remediation can be provided. However, limited road capacity and high demand mean that LoS E and LoS F are regularly experienced by motorists, particularly during peak periods.

4. Existing environment

4.1 Existing road network

Transport uses a hierarchal system that designates the road network into State Roads, Regional Roads and Local Roads based on the predominately function of a road. The process of classification of roads allows the function of the road to remain generally compatible with surrounding land use and the intended use of the road primarily either for movement or access. Under the NSW Road Management Arrangement between Transport and councils, three categories of roads are defined:

- **State roads** – These are the major arterial roads that carry people and goods within Sydney, Newcastle, Wollongong and the Central Coast urban areas, and also connect major regional towns, major regions of the state and interstate. Transport has responsibility for managing the primary function of these roads and state roads are maintained either by Transport or through contractual arrangements with Councils. State roads include motorways and primary arterial roads.
- **Regional roads** – These are roads of secondary importance. These perform a sub-arterial function. Regional roads are the responsibility of councils to manage. Regional roads include secondary and sub-arterial roads.
- **Local roads** – These comprise the remaining council controlled roads, providing for local circulation. Local roads are the responsibility of councils to manage. Local roads include collector roads and local roads.

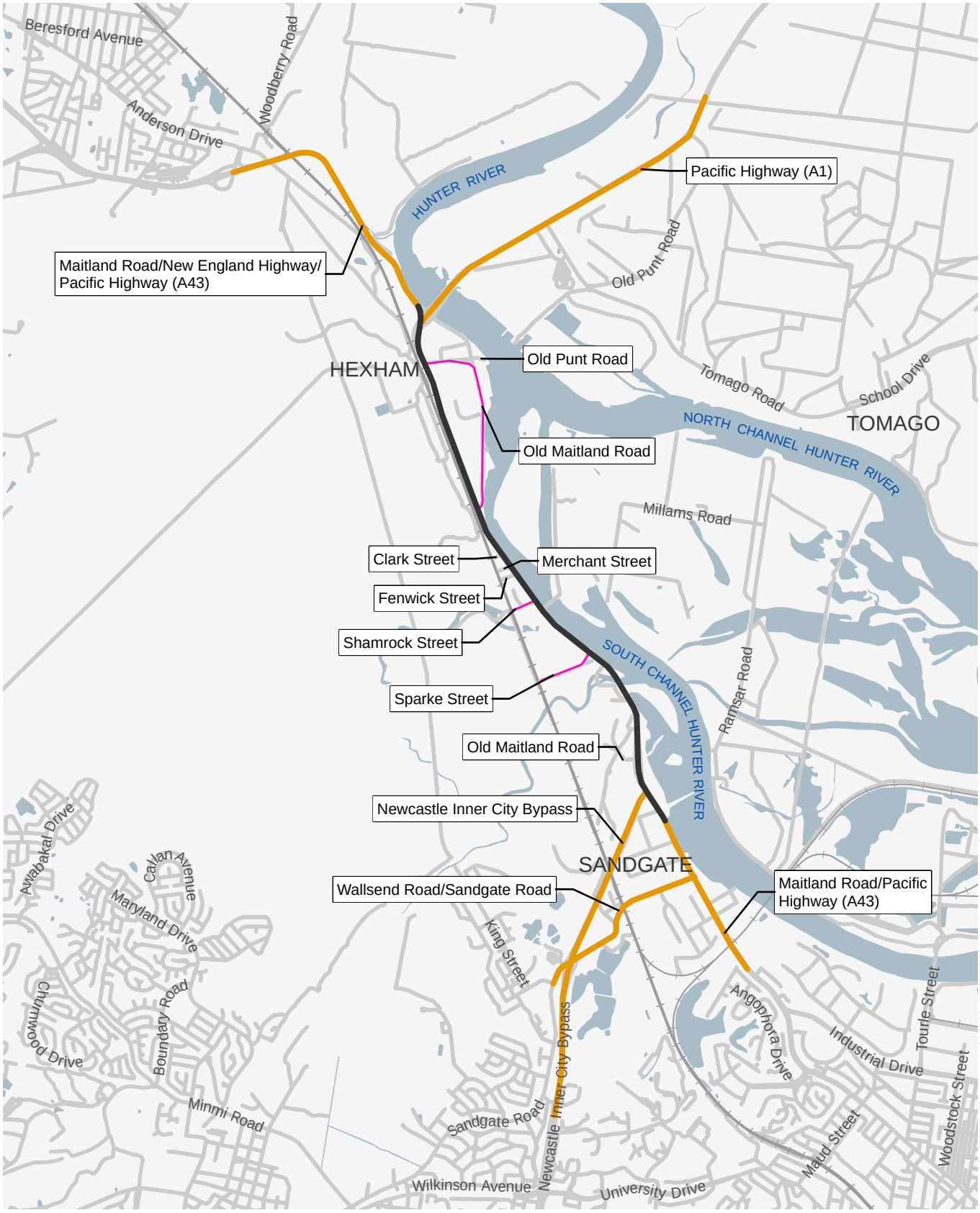
The study area also includes roads which form part of the National Land Transport Network (NLTN). The NLTN is a network of nationally important road and rail infrastructure links and their intermodal connections.

The functional hierarchy of the existing road network within the study area is presented in **Figure 4.1**. Local roads in the study area are discussed further in **Section 4.1.2**.

4.1.1 State and regional road network and infrastructure

A summary of the existing traffic conditions at key state and regional road corridors within the study area is provided below:

- **Maitland Road/Pacific Highway/New England Highway** – In the study area, the section of Maitland Road within the proposal is about six kilometres long starting around 290 metres to the south of the intersection with the Newcastle Inner City Bypass at Sandgate and extending to around 760 metres north of Hexham Bridge at Hexham. The section of Maitland Road to the east of the A1 Pacific Highway intersection that is located to the south of the Hunter River and Hexham Bridge is also recognised as the Pacific Highway (A43). The section of Maitland Road to the west of the A1 Pacific Highway intersection that is located to the south of the Hunter River and Hexham Bridge is also recognised as the New England Highway (A43) and the A1 Pacific Highway. For the purposes of this report this section of road will be referred to as Maitland Road. The sections of Maitland Road within the proposal area is comprised of a dual carriageway road, generally with two lanes in each direction and an 80 kilometres per hour speed limit. It forms part of the National Land Transport Network (NLTN). Traffic surveys carried out in 2017 on Maitland Road recorded an average of more than 56,100 vehicles (16 per cent heavy vehicles) per day south of Old Maitland Road (south) and 61,000 vehicles (17 per cent heavy vehicles) per day on the section of Maitland Road north-west of Hexham Bridge and the intersection with the A1 Pacific Highway.



Legend

- Proposal study corridor
- Key state roads relevant to the proposal
- Local roads
- Waterway
- Railway
- Road

0 1 2 km

Scale 1:50,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.1 Road network

Hexham Straight Widening

- **Newcastle Inner City Bypass** – The A37 Newcastle Inner City Bypass provides an orbital road within Newcastle's road network to connect the A43 Pacific Highway at Bennetts Green with the A43 Pacific Highway at Sandgate. In the study area, it is a dual carriageway road with generally two lanes in each direction and has a speed limit of 90 kilometres per hour. The Newcastle Inner City Bypass carries an average of more than 24,200 vehicles (12 per cent heavy vehicles) per day just south of the Pacific Highway, based on surveys undertaken.

4.1.2 Local road network and infrastructure

- **Old Maitland Road, Sandgate (north of NICB)** – Old Maitland Road, Sandgate is a two-way, no through road that intersects with Maitland Road about 320 metres north of the Newcastle Inner City Bypass and Maitland Road intersection. The road has a speed limit of 50 kilometres per hour and provides access to a number of land uses including industrial properties and Calvary St Joseph's Retirement Community at Sandgate
- **Sparke Street** – Sparke Street is a two-way, no through road that intersects with Maitland Road about 1,400 metres north of the Maitland Road and Newcastle Inner City Bypass intersection. The road has a speed limit of 50 kilometres per hour and provides access to heavy industrial properties including a recycling centre
- **Shamrock Street** – Shamrock Street is a two-way road that intersects with Maitland Road in Hexham. Shamrock Street provides access to a variety of land uses including residential properties, commercial (McDonalds) and a truck port. At the end of Shamrock Street there is a railway level crossing that provides access to the rail corridor and western side of the rail tracks
- **Fenwick Street** – Fenwick Street is a no through road that intersects with Maitland Road about 300 metres north of the Shamrock Street and Maitland Road intersection. The road is about 100 metres long, has posted speed limit of 50 kilometres per hour and provides access to about 10 residential properties
- **Merchant Street** – Merchant Street is a no through road that intersects with Maitland Road about 370 metres north of the Shamrock Street and Maitland Road intersection. The intersection only allows vehicles to turn left into and out of Merchant Street. The road is about 100 metres long, has no posted speed limit and provides access to about 10 residential properties
- **Clark Street** – Clark Street is an unpaved, no through road that intersects with Maitland Road about 500 metres north of the Shamrock Street and Maitland Road intersection. The intersection only allows vehicles to turn left into and out of Clark Street. The road provides access to a single residential property
- **Old Maitland Road, Hexham** – Old Maitland Road at Hexham is a 1.7 kilometre two-way, ring road which intersects Maitland Road at two locations. The southern intersection of Old Maitland Road and Maitland Road is to the south of Hexham Bowling Club, the northern intersection of Old Maitland Road at Maitland Road is to the north of Hexham Railway Station. The road provides access to both residential and heavy industrial properties
- **Old Punt Road** – Old Punt Road in Hexham is a two way 250 metre paved road without shoulders. It intersects with Old Maitland Road and provides access to a few industrial properties and Hunter River.

4.1.3 Traffic growth

Traffic volumes were extracted from Transport's traffic volume viewer (Transport for NSW, 2020) at two traffic counting stations in the modelled area. There were no Transport traffic volume counters situated on Maitland Road within the study area, the two stations are to the north and east of Hexham Straight and would provide an indicative indication of traffic growth in the study area. The location of these counters is:

- ID 05001 – located on Pacific Highway (A1), 380 metres west of Tomago Road, Tomago
- ID 05055 – located on New England Highway, 400 metres east of Woodlands Close, Tarro.

These stations comprised of permanent and temporary traffic counts; thus, data was not available for every year. This data was used to assess the traffic growth within our study area. The average annual daily traffic (AADT) counts for each year are displayed in **Table 4.1**. The results indicate that historically traffic has experienced an increase of about two to three per cent each year. However, the data displays a stagnation of traffic growth since 2015, with the rate of increase reducing to about one per cent AADT growth.

Table 4.1 Recorded AADT at traffic counting stations within the study area

Location	AADT														Growth rate per year
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Pacific Highway	38,094	38,276*	38,653	39,551	40,500	41,853	42,809	42,992*	42,625	47,342*	47,405*	-	48,614*	48,477	1.9%
New England Highway	32,321	35,114*	-	-	-	-	-	-	-	-	32,314*	-	-	-	0.0%

*Indicates traffic data was not recorded for the majority of the year, thus the calculated AADT may be subject to seasonal variation

4.1.4 Daily and seasonal variation in traffic volumes

A Transport permanent count station (ID 05001) is located on the A1 Pacific Highway, 380 metres west of Tomago Road, Tomago, and was used to assess daily and seasonal variations in traffic volumes. The assessment was based on the last full year of available data which was 2019 for station ID 05001.

Traffic volumes vary by day of the week with a noticeable difference between weekday and weekend traffic volumes. **Table 4.2** shows a comparison between the AADT and the annual average traffic volumes for weekdays, weekends and school holiday periods. Weekday traffic volumes are higher than weekend traffic volumes, and school holiday volumes are higher than weekend volumes but less than weekday volumes.

Table 4.2 Seasonal variation in traffic at traffic counter station 05001

Permanent count station	AADT	% of AADT		
		Annual average weekday	Annual average weekend	Annual average school holiday
Pacific Highway	48,564 (2017)	52,542 (108% of AADT)	36,399 (75% of AADT)	45,599 (94% of AADT)

Figure 4.2 shows the seasonal profiles of traffic at the permanent count station. The data shows seasonal fluctuations in traffic volumes with peaks that coincide with the Christmas and New Year period, Easter and the July and October school holidays. The average daily traffic volume during these periods is substantially higher than the average for the year.

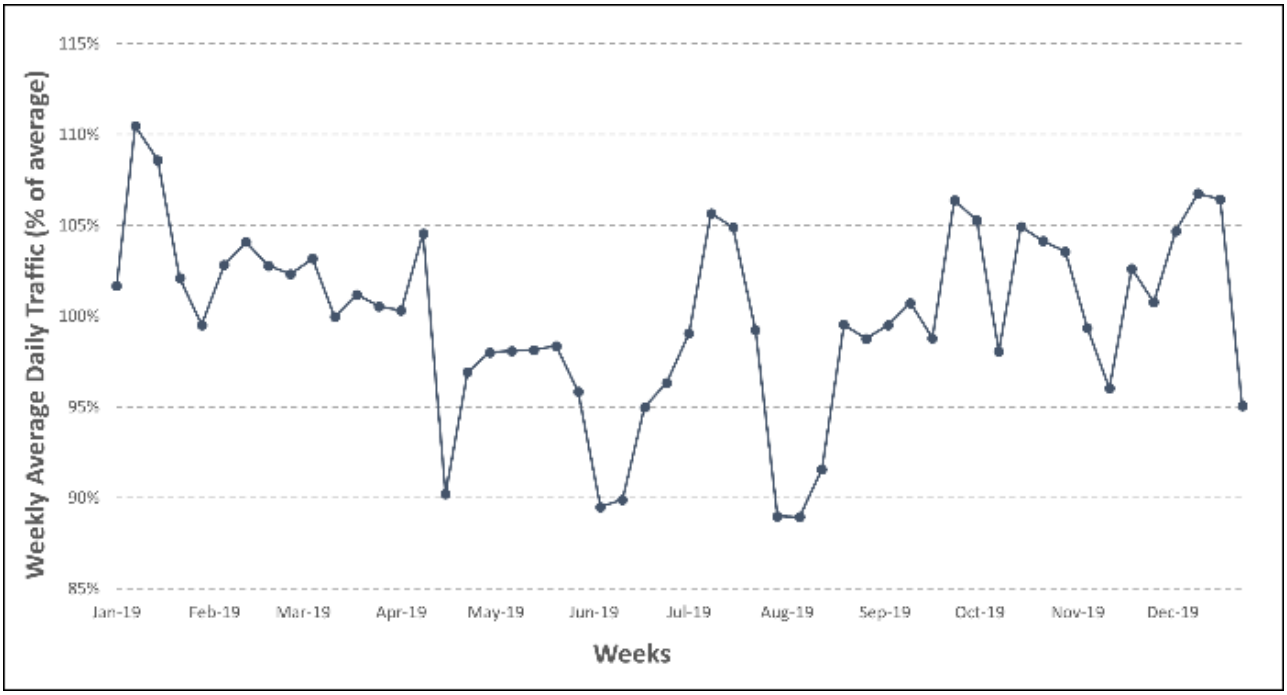


Figure 4.2 Weekly traffic volumes from traffic counter station 05001 in 2019

4.2 Road safety and crash history

An in-depth crash analysis has been undertaken as part of this assessment, the investigation identified the following trends in relation to crashes on the proposal corridor from the Wallsend Road and Maitland Road intersection to Hexham Bridge:

- A total of 178 crashes were recorded in the five-year period from October 2013 – September 2018 inclusive. A further 10 crashes were recorded during the provisional period from October 2018 – March 2019
- For the five-year period, approximately 15 per cent (26 out of 178) of crashes were fatal or serious injury (FSI) crashes
- The number of crashes along the corridor peaked in 2014, with 44 crashes recorded, including one fatal crash. Since then, the number of crashes has decreased to 23 in 2017, however, increased to 27 crashes in 2018 by the end of September 2018
- Locations which exhibit a high crash history include:
  - A1 Pacific Highway and Maitland Road intersection (8 per cent of crashes)
  - Old Maitland Road (north) and Maitland Road intersection (7 per cent of crashes)
  - Midblock road section on Maitland Road between the A1 Pacific Highway and Maitland Road intersection and the Old Maitland Road (south) and Maitland Road intersection (8 per cent of crashes)
- The following corridor sections recorded crash rates above the associated NSW average rates:
  - Serious injury and casualty crashes: Between the A1 Pacific Highway and Maitland Road intersection and the Old Maitland Road (south) and Maitland Road intersection
  - Fatality crashes: Between the section of Maitland Road from Sparke Street to before Old Maitland Road (south)
- The most prevalent crash movement type in the corridor was found to be rear-end crashes (65 per cent), followed by off-road movement on a straight section of road and hitting an object (10 per cent) and lane changes (6 per cent). Some recorded key distraction factors which may have contributed to the rear-end crashes included being distracted inside the vehicle, distractions outside, other distraction factors and falling asleep or drowsiness. Other key error factors included braking hard, someone suddenly departing a vehicle and excessive speed
- The majority of crashes involved a motor vehicle, accounting for 88 per cent of all crashes. Thirteen per cent involved a heavy truck, 28 per cent of crashes involved a light truck and seven per cent involved a motorcycle. In terms of vulnerable road users, two per cent of crashes involved cyclist and one per cent involved pedestrians
- Forty-one per cent of crashes were recorded at signalised intersections, one per cent of total crashes were recorded at unsignalised intersections and 58 per cent of crashes occurred mid-block along the corridor
- In the provisional period (October 2018 – March 2019.), 10 crashes were recorded. Thirty per cent occurred at intersections and 70 per cent occurred along mid-block sections. 90 per cent were the result of a rear-end collision and 10 per cent were the result of becoming out of control on a bend.

4.3 Existing land use

The land use along the proposal is characterised by a mix of transport corridors (road and rail), environmental areas including wetlands and waterways, recreational areas both public and private and light and heavy industrial areas. Some residential properties are located in areas identified as environmental living. The main features of the proposal area and its surrounds are discussed in **Section 1.1.5.**

One truck port is located in the study area. It is located in Hexham just north of Shamrock Street and is accessed from either the northbound traffic lane on Maitland Road or Shamrock Street. This area provides access to fuel, food and the opportunity for a brief rest for both light and heavy vehicles.

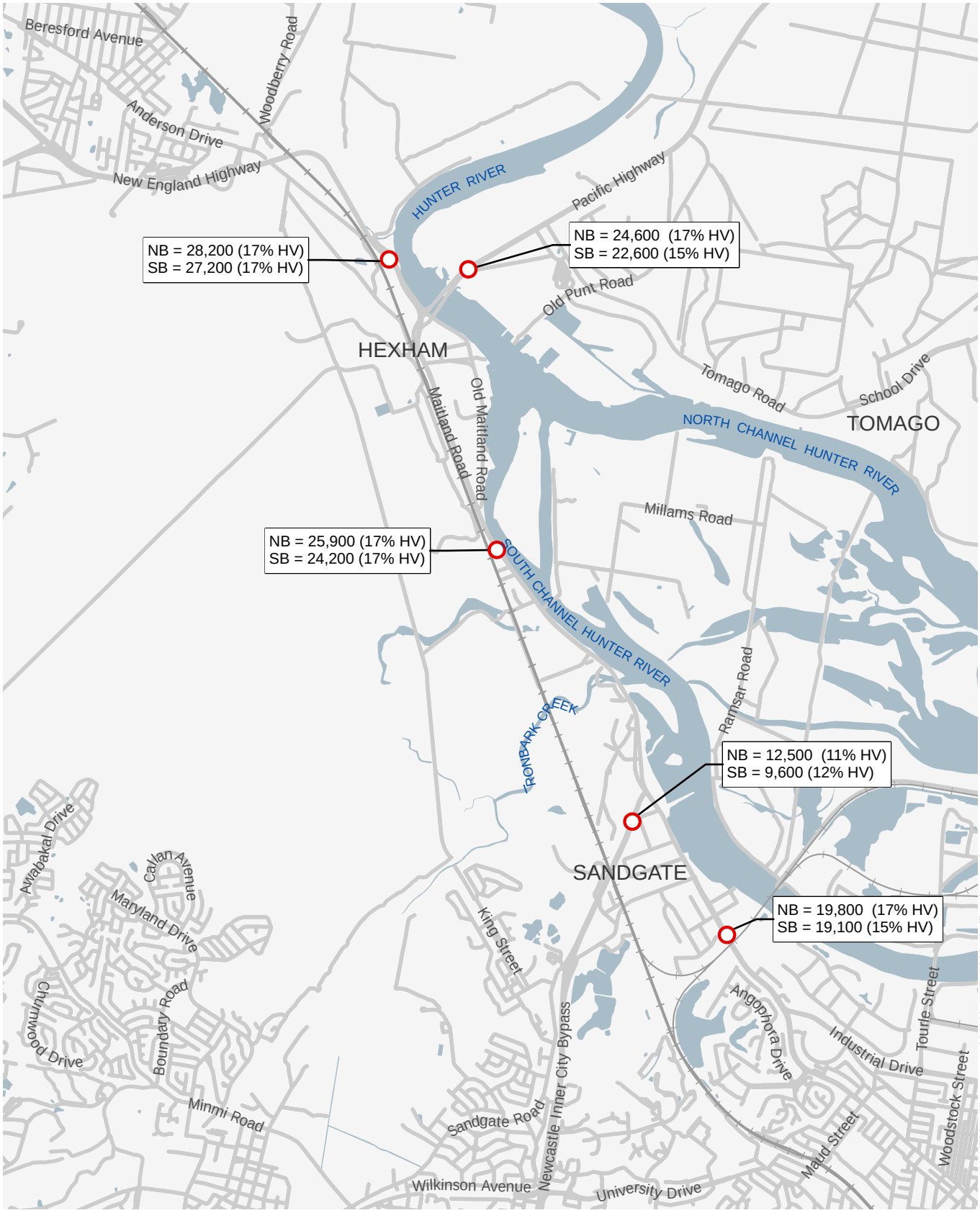
Limited formal public parking available exists within the study area. Most formal parking areas are associated with businesses and industrial developments. Parking is not permitted on the state and regional roads in the study area. Informal public parking in the study area therefore is limited to limited to verges and local roads.

4.4 Existing road performance

The results from traffic surveys and assessment of existing traffic performance from the base model development have been summarised in the sections below.

4.4.1 Traffic volumes

Traffic surveys were undertaken between 10 October 2017 and 23 October 2017 at various locations in the study area to gain an understanding of daily traffic volumes and traffic composition. The average daily traffic volumes observed on key routes throughout the network are presented in **Figure 4.3**.



Legend

- Traffic volume survey locations
- Railway
- Road
- Waterway

0 1 2 km

Scale 1:50,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.3 Daily traffic volumes of key routes in the network

4.4.2 Travel time

Travel times and travel speeds provide a means of assessing the functional performance of the road network in a way that is consistent with the experience of road users through their day-to-day travel.

Travel times along the segments shown in **Figure 4.4** were extracted from the 2017 base model. **Table 4.3** displays the recorded travel times for the morning peak period and evening peak period respectively.

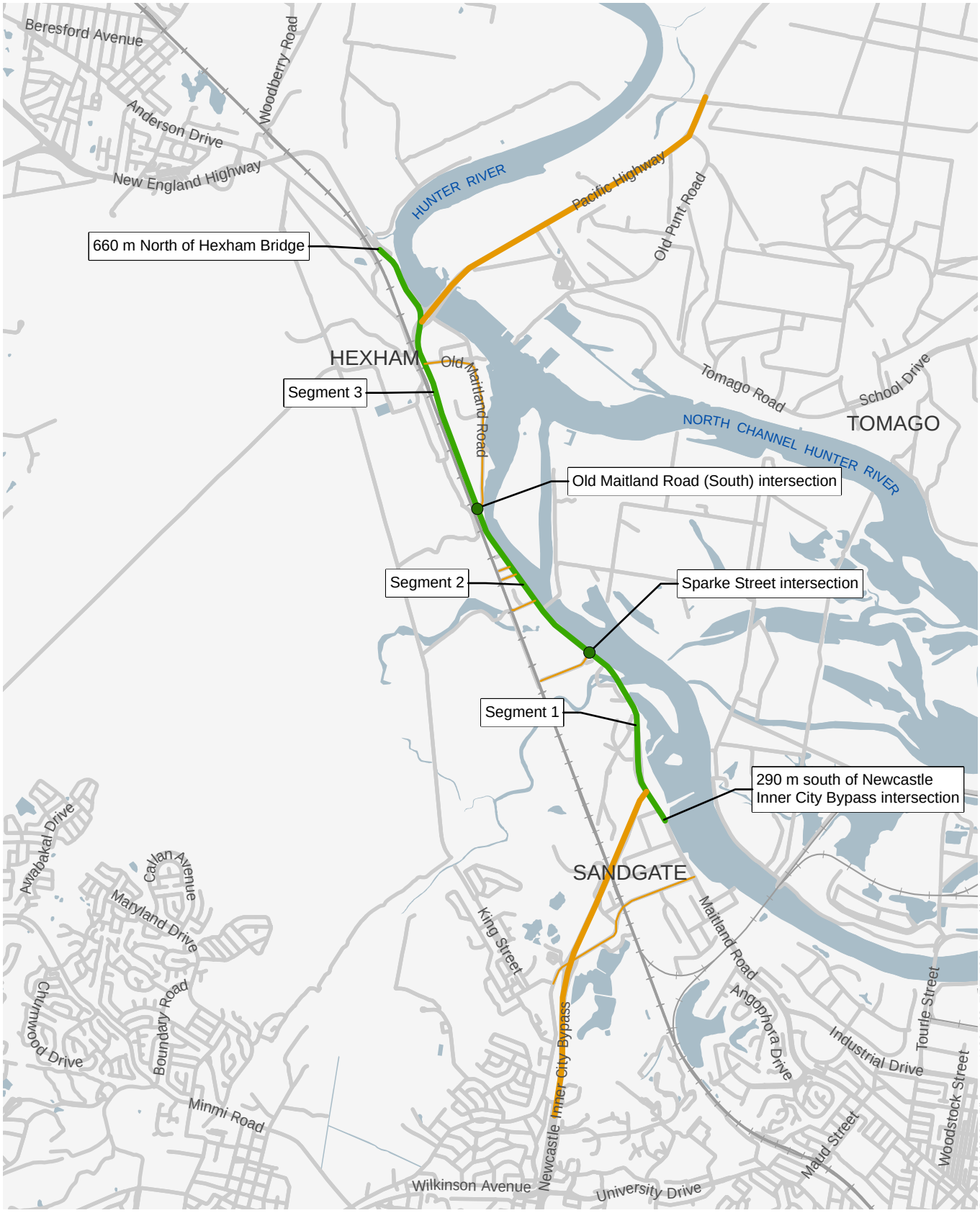
Table 4.3 Existing travel time

Segment	Direction	Distance (km)	Travel time (min:sec)		Travel speed (km/h)	
			8-9am	5-6pm	8-9am	5-6pm
Segment 1	Southbound	1.79	01:38	01:39	66	65
Segment 2	Southbound	1.69	02:00	01:37	51	63
Segment 3	Southbound	2.43	03:21	02:32	44	58
Full Length	Southbound	5.91	06:58	05:48	51	61
Segment 1	Northbound	1.80	02:07	02:42	51	40
Segment 2	Northbound	1.70	01:48	01:58	57	52
Segment 3	Northbound	2.42	02:25	02:32	60	57
Full Length	Northbound	5.92	06:20	07:12	56	49

In the morning peak, there is a higher flow of traffic in the southbound direction towards Newcastle, while in the evening peak, the peak traffic flow is northbound, away from Newcastle. These directional peak traffic flows are reflected in the travel time results as a higher volume of traffic results in reduced travel speeds and increase travel times.

The segment between the northern extent of upgrades and Old Maitland Road (south) (Segment 3) operates with the lowest speed of the three segments in the morning peak due to the large southbound traffic demand and the three to two lane merge just south of Old Maitland Road (north).

The segment between 290 metres south of the Newcastle Inner City bypass and Sparke Street (Segment 1) operates with the lowest speed of the three segments in the evening peak. These delays are mostly caused by the Newcastle Inner City Bypass and Maitland Road intersection which has a high traffic demand from all three approaches to the intersection.



Legend

- Railway
- Road
- Waterway
- Proposal study corridor
- Key roads
- Travel time segment boundary

0 1 2 km

Scale 1:50,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.4 Travel time survey routes

4.4.3 Intersection performance

The traffic modelling results from the calibrated and validated 2017 base model were extracted to gain an understanding of current performance for the following intersections:

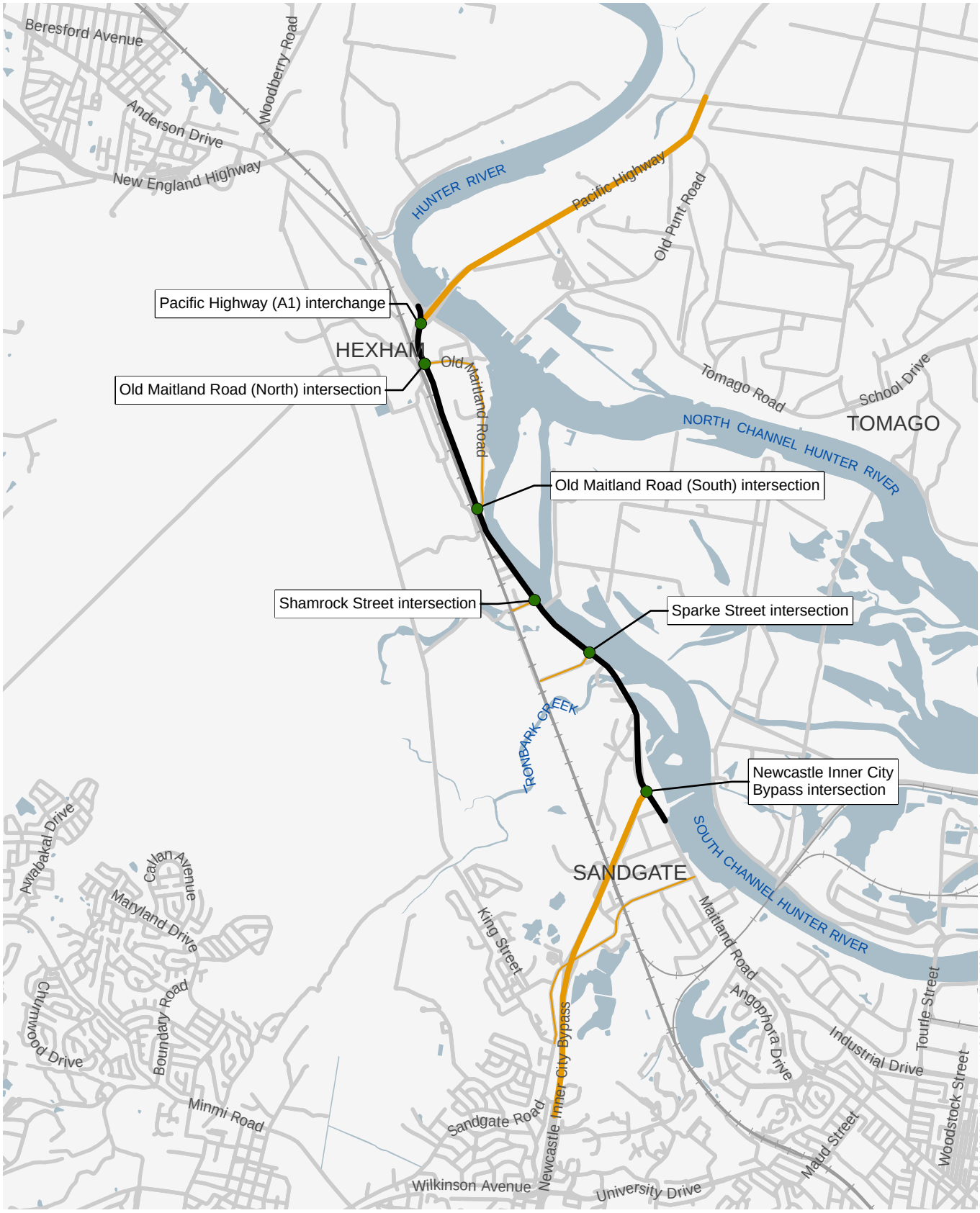
- Wallsend Road and Maitland Road
- Newcastle Inner City Bypass and Maitland Road
- Sparke Street and Maitland Road
- Shamrock Street and Maitland Road
- Old Maitland Road (south) and Maitland Road
- Old Maitland Road (north) and Maitland Road
- A1 Pacific Highway and Maitland Road.

Intersection delays and LoS for these intersections within the study area for the morning and afternoon peak periods is provided in **Table 4.4**. These results are based on modelled average delay for the morning and evening peak hour in the VISSIM model.

Table 4.4 Performance of modelled intersections in 2017

Intersection	Type	Morning peak (8-9am)		Evening peak (5-6pm)	
		Avg delay (sec)	LoS	Avg delay (sec)	LoS
Newcastle Inner City Bypass and Maitland Road	Signalised	36	D	50	D
Old Maitland Road (north of NICB) and Maitland Road	Seagull signalised	21	C	44	D
Sparke Street and Maitland Road	Seagull signalised	8	A	15	B
Shamrock Street and Maitland Road	Signalised	16	B	13	B
Old Maitland Road (south) and Maitland Road	Signalised	8	A	7	A
Old Maitland Road (north) and Maitland Road	Signalised	10	B	8	A
A1 Pacific Highway and Maitland Road	Signalised	22	C	7	A

The worst performing intersection is Newcastle Inner City Bypass and Maitland Road intersection which operates at a LoS D and contributes to increased travel times and reduced travel speeds in the segment of Maitland Road between the section of the road located 290 metres south of the Newcastle Inner City Bypass and extending to Sparke Street. Overall, the intersection delay and LoS for all intersections in the study area are satisfactory operating at LoS D or better in 2017 during the peak hours.



Legend

- Railway
- Road
- Waterway
- Proposal study corridor
- Key roads considered in the proposal model
- Key intersections

0 1 2 km

Scale 1:50,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.5 Location of intersections assessed in the traffic model

4.5 Public transport

4.5.1 Passenger rail network

The rail network in the study area consists of the Main North Rail Line, with four tracks that broadly run parallel to Maitland Road in the proposal area and primarily serves passenger and freight traffic. The study area contains two railway stations located at Hexham and Sandgate as shown in **Figure 4.6**. These stations are serviced by the Hunter Line, which is an intercity line operated by NSW TrainLink and connects Hamilton (Newcastle) with Maitland, Scone and Dungog.

The number of train services stopping at each station in the study area is shown in **Table 4.5**. The average morning peak hour service frequency at Hexham and Sandgate towards Hamilton (Newcastle) is 60 minutes. Similarly, in the evening peak hour, is 30 to 60 minutes at Hexham and Sandgate.

Table 4.5 Scheduled Hunter Line train services in the study area (as of January 2020)

Station	Towards	No. morning peak services (6am to 10am)	No. evening peak services (3pm to 7pm)	Total weekday services	Total weekend services
Sandgate	Hamilton (Newcastle)	4	4	23	21
	Scone and Dungog	4	5	26	22
Hexham	Hamilton (Newcastle)	4	4	23	21
	Scone and Dungog	4	5	26	22

The Main North Rail Line is also used by NSW TrainLink regional services between Sydney and Moree, Armidale, Grafton, Casino and Brisbane. However, these trains do not stop at stations in the study area. The nearest stations serviced by these trains are Broadmeadow and Maitland. The number of NSW TrainLink regional services is shown in **Table 4.6.**

Table 4.6 Scheduled NSW TrainLink regional services (as of January 2020)

NSW TrainLink service	No. of daily services towards Sydney	No. of daily services away from Sydney
Between Sydney and Moree	1	1
Between Sydney and Armidale	1	1
Between Sydney and Grafton	1	1
Between Sydney and Casino	1	1
Between Sydney and Brisbane	1	1

Legend

- Railway station
- Railway
- Road
- Waterway

0 1 2 km

Scale 1:35,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.6 Rail network in the study area

Rail patronage

The rail patronage in the region is relatively low. Within the study area in 2019, just over 10,700 Opal tap on or offs were recorded at Hexham Railway Station. This equates to under 30 rail journeys per day. Hamilton Station located in central Newcastle is the most common origin or destination for commuters and accounts for 27 per cent of all trips to or from Hexham Railway Station. Maitland Station accounts for 13 per cent and Waratah Station which provides access to Newcastle University accounts for 11 per cent of origins or destinations of rail trips to and from Hexham railway Station. The combined origin and destinations of rail patronage to and from Hexham station are shown in **Figure 4.7.**

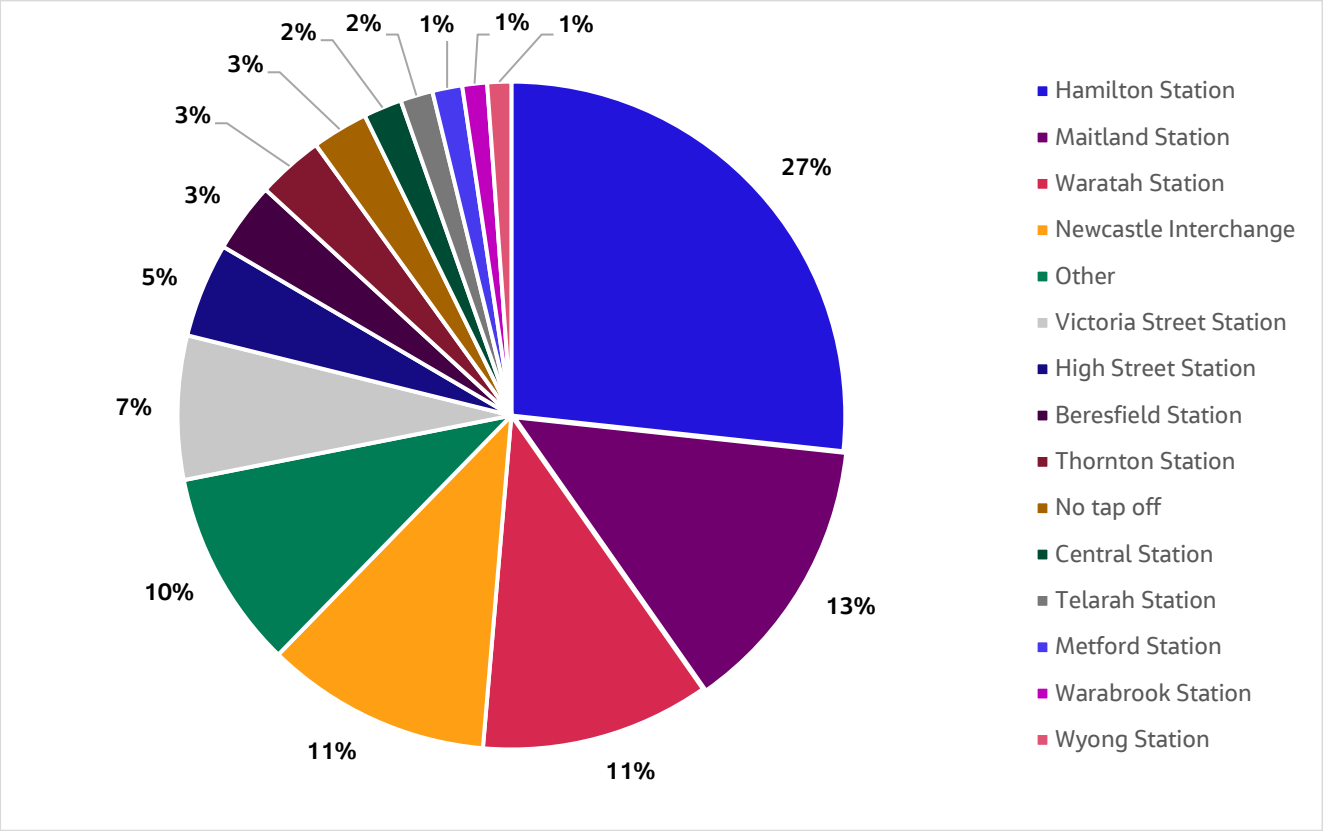


Figure 4.7 Combined origin or destination for rail patronage at Hexham Station

4.5.2 Bus services

The bus network in the study area consists of local buses and regional coach services. These are described below.

Local buses

The bus network in the study area consists of local buses and long-distance coach services. Local bus services near the proposal provide connections to Newcastle, Raymond Terrace and Cessnock. Public transport bus services that use Maitland Road within the study area include:

- Route 47, which operates between Jesmond and Marketown, via Warabrook
- Route 140, which connects Newcastle Interchange and Raymond Terrace, via Maitland Road and the Pacific Highway
- Route 150, which connects Taree to Newcastle via Forster, Hawks Nest and Tea Gardens
- Route 151, which connects Taree to Newcastle via Forster and The Rock
- Route 152, which connects Hawks Nest and Newcastle
- Route 160, which connects Newcastle and Cessnock via the Newcastle Inner City Bypass, Maitland Road, New England Highway and John Renshaw Drive.

Routes 150, 151 and 152 do not service bus stops in the study area, with the closest bus stops to the study area at Newcastle and Raymond Terrace.

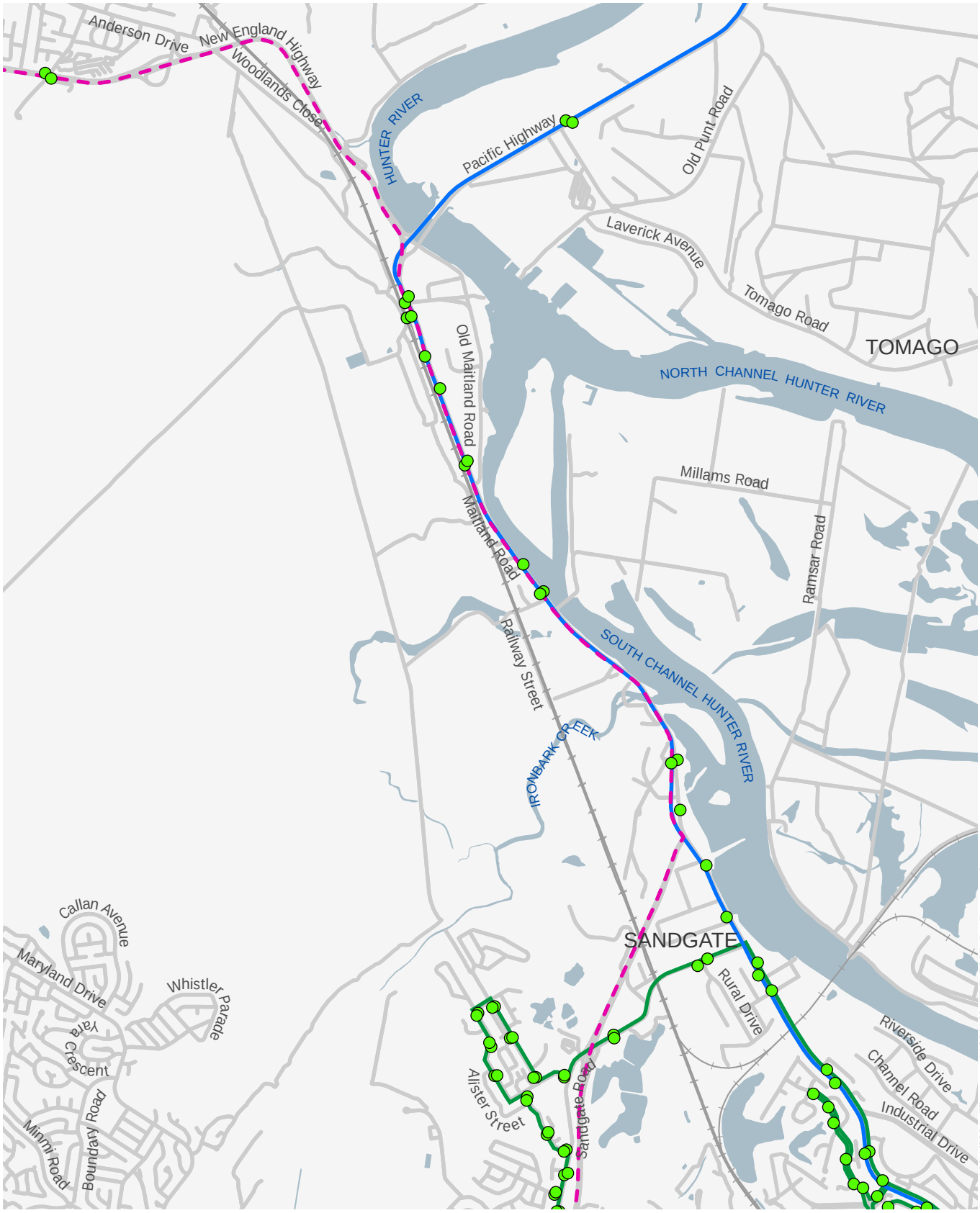
Maitland Road within the study area is also used by 22 school bus routes that provide access for students in Raymond Terrace, Maitland, Clarence Town, Woodberry and Beresfield to schools and educational facilities in Newcastle, Raymond Terrace and Maitland.

Details of bus services in the study area are shown in **Table 4.7** and **Figure 4.8.**

Table 4.7 Local bus services in the study area (as of January 2020)

Route	Direction of travel	Bus operator	No. of morning peak services (6am to 10am)	No. of evening peak services (3pm to 7pm)	Total weekday services	Total Saturday services	Total Sunday services
47	Jesmond to Marketown via Warabrook	Newcastle Transport	4	3	13	12	10
	Marketown to Jesmond via Warabrook		3	4	13	12	10
140	Lakeside Shops to Newcastle via Raymond Terrace and Hexham	Hunter Valley Buses	8	9	27	15	5
	Newcastle to Lakeside Shops via		7	7	24	13	5

Route	Direction of travel	Bus operator	No. of morning peak services (6am to 10am)	No. of evening peak services (3pm to 7pm)	Total weekday services	Total Saturday services	Total Sunday services
	Hexham and Raymond Terrace						
	Thornton to Rutherford via Ashtonfield, Stockland Green Hills and Maitland		4	4	15	13	5
160	Cessnock to Newcastle Interchange	Rover coaches	3	1	5	2	0
	Newcastle Interchange to Cessnock		2	2	5	2	0



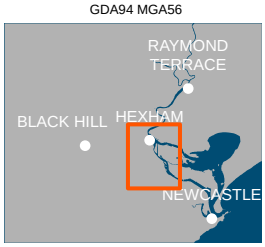
Legend

- Bus stop
- Bus route
  - 47
  - 140
  - 160
- Railway
- Road
- Waterway

0 1 2 km

Scale 1:40,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.8 Bus stops and bus services operating within the study area

Public bus patronage

The public bus patronage in the region is relatively low. Within the study area in 2019, a total of 6,490 Opal tap on or offs were recorded This equates to under 18 bus journeys per day. The location of tap on and offs is shown in **Figure 4.9.** The size of each bubble represents the number of tap on and offs at each location, with the split of touch on and offs are also shown via colour shadings. The most common Opal tap on location was the bus stop at Hexham Bowling Club, Maitland Road, which accounted for just under one third of all tap ons. Maitland Road opposite Old Maitland Road (south) was the most common tap off location accounting for 29 per cent of all tap offs.

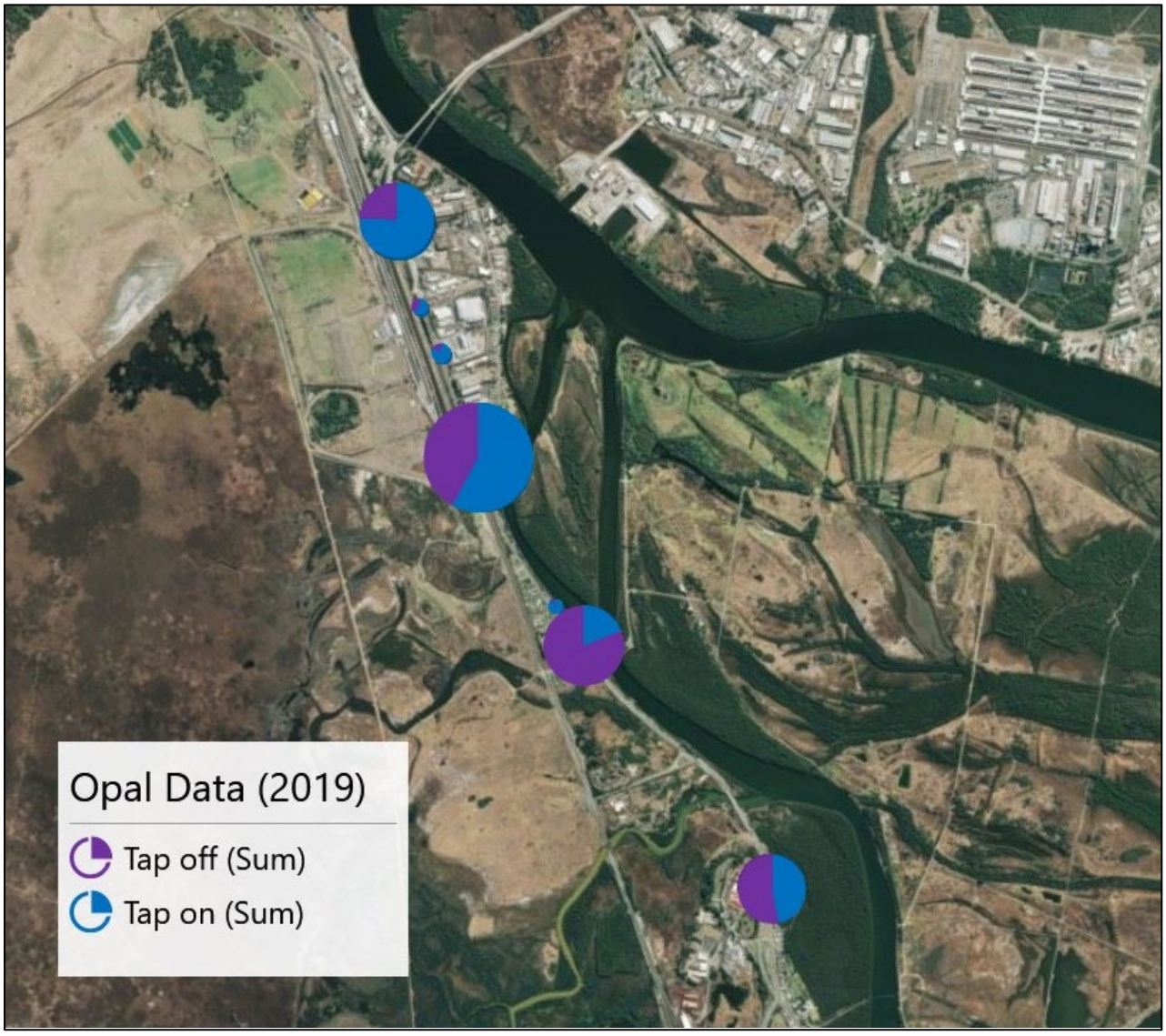


Figure 4.9 Opal tap on and off locations in 2019 within the study area

4.6 Pedestrian and bicycle networks

4.6.1 Pedestrian network

The pedestrian network in the study area is limited to the following facilities:

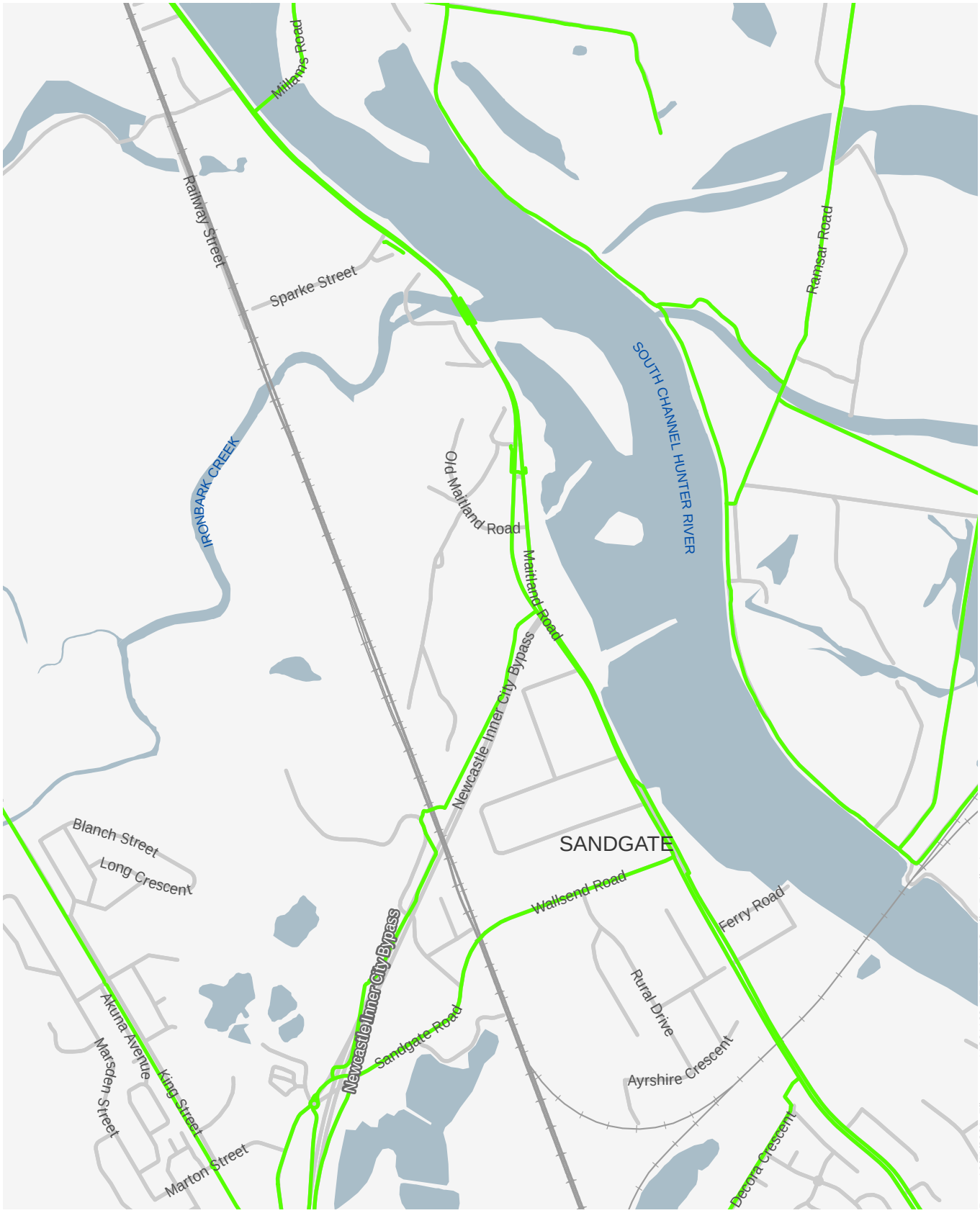
- On the western side of Maitland Road between the Newcastle Inner City Bypass and 100 metres south of the Newcastle Inner City Bypass and Maitland Road intersection
- The eastern side of Maitland Road between Hexham Bridge and Old Maitland Road (north)

Signalised pedestrian crossings at the following locations:

- Newcastle Inner City Bypass and Maitland Road intersection – across the southern and eastern leg of the intersection
- Pedestrian operated signals on Maitland Road about 10 metres to the north of the northbound U-turn facility opposite Calvary St Joseph's Retirement Community at Sandgate
- Sparke Street and Maitland Road intersection – across the southwest leg of the intersection
- Shamrock Street and Maitland Road intersection – across the northern leg of the intersection
- Old Maitland Road (south) and Maitland Road intersection – across the southern and eastern leg of the intersection
- Old Maitland Road (north) and Maitland Road intersection – across the southern and eastern leg of the intersection.

4.6.2 Bicycle network

The bicycle network in the proposal area is facilitated by Maitland Road shoulders which provides dedicated on road bike baths for most of the study area. Inter-regional cycling movements in the area surrounding road area is shown in **Figure 4.10**, the routes in the proposal area are classified by the *Cycleway Finder V3* (Transport, 2020) as high difficulty routes.



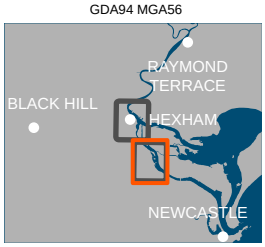
Legend

- Existing cycle network
- Railway
- Road
- Waterway

0 1 1 km

Scale 1:18,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 4.10a Existing cycling infrastructure

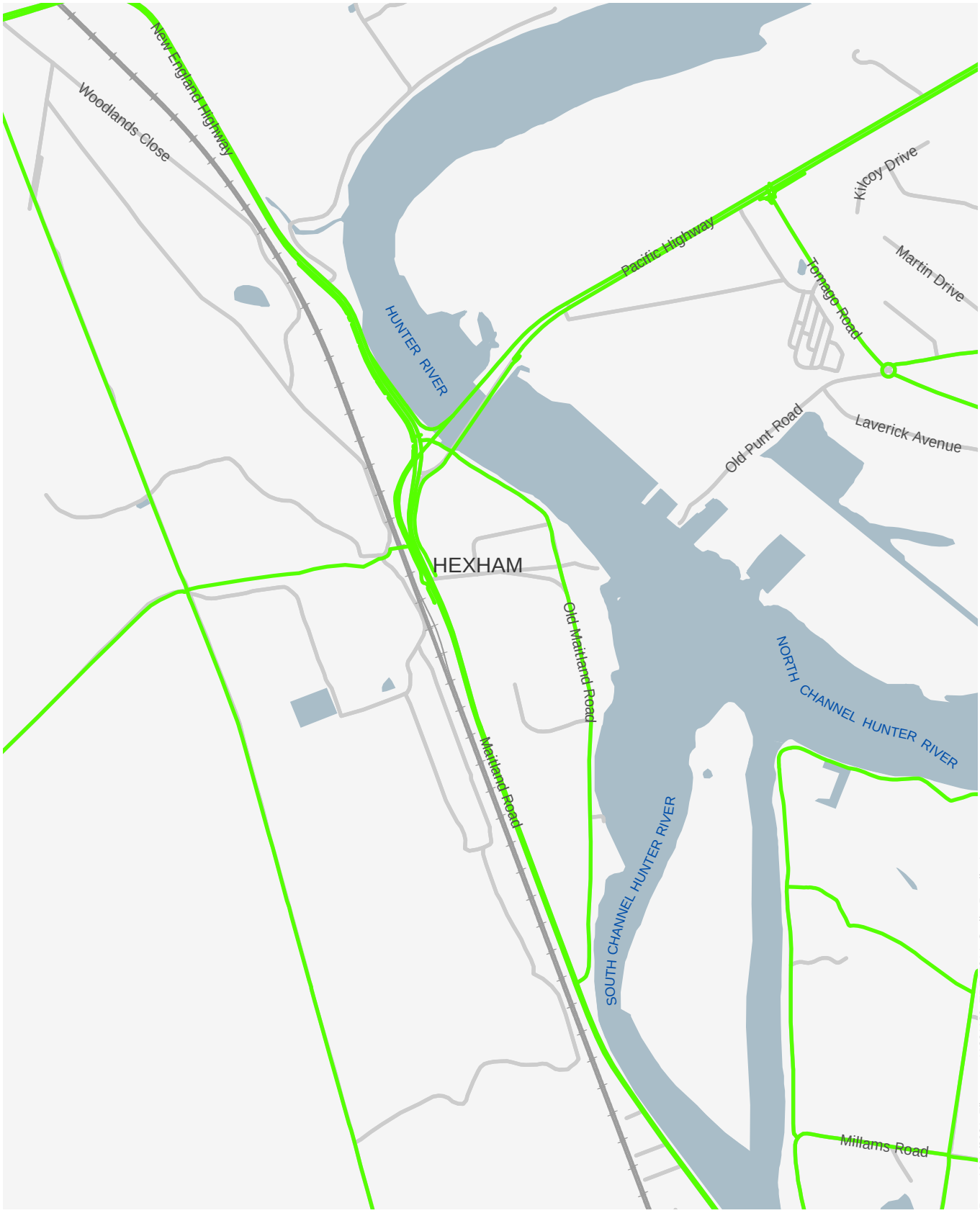


Figure 4.10b Existing cycling infrastructure

5. Impact assessment

5.1 Construction impacts

5.1.1 Construction activities and indicative program

The construction impact assessment has considered an indicative construction program, however further details are anticipated as the construction staging design is developed and major procurement is completed for the main works delivery contractor(s). The timing and duration of construction activities may also be influenced by, but not limited to, the following:

- Approvals
- Inclement weather
- Bridge demolition and construction methodology
- Alternative pavement design solutions
- Final detailed design
- Changes to materials and/or construction methods
- Co-ordination with utility authorities
- Community interests or complaints that may need to be addressed
- Interfacing projects
- Any Early Works Package for critical utilities
- Traffic management requirements.

5.1.2 Indicative construction staging

Indicative construction staging plans have been developed to ensure the capacity of the roadway is maximised, and that existing capacity is not diminished where possible. Six stages have been developed for the construction works which are described below.

Stage 1 works include:

- Establishment work including establishing construction compounds and ancillary facilities, vegetation clearing, site preparation, geotechnical investigations, utilities potholing
- Installation of traffic barriers to facilitate works within the median. Live traffic would remain within the existing lanes
- Construction of median pavement (not including permanent redirective kerbs)
- Drilling of temporary piles for construction barges and/or construction of a temporary bridge or rock platforms for the piling and pier construction in the creek
- Installation of bridge pier piles, erection of bridge piers and installation of bridge abutments
- Construction of the northern and southern bridge abutment earthworks
- Protection of underground and overhead utility crossings to be retained
- Relocation of utilities on the south and north bridge abutments
- Relocation of traffic signals that are placed on the median widening areas.

Stage 2 works include:

- Installation of traffic barriers to facilitate works mainly along the southbound shoulder and some works along the northbound shoulder at the southern end of the proposal Generally southbound traffic would utilise the median pavement completed in Stage 1
- Temporary line marking
- Construction of pavement widening mainly along southbound shoulder and pavement widening along northbound shoulder at the southern end of the proposal
- Construction of the Ironbark Creek bridge superstructure
- Construction of new southbound bridge pavements and earthworks
- Extension of culverts
- Construction of retaining walls to the south of Ironbark Creek
- Protection of underground and overhead utility crossings to be retained
- Completion of the relocation of utilities to the southbound bridge abutments
- Relocation of water main currently attached to the superstructure of the existing bridge
- Relocation of utilities that are interfacing with the proposed widening area on the southbound.

Stage 3 works include:

- Installation of traffic barriers to facilitate works mainly along the northbound shoulder. Generally northbound traffic would utilise the median pavement completed in Stage 1 and southbound traffic would utilise the shoulder pavement widening completed in Stage 2. Southbound traffic would also be diverted to the new southbound lanes on the completed bridge
- Construction of pavement widening along northbound shoulder of the proposal
- Construction of new northbound bridge pavements and earthworks
- Extension of culverts
- Construction of retaining walls
- Construction of shared path at the northern end of the proposal
- Protection of underground and overhead utility crossings to be retained
- Completing relocation of utilities to the northbound bridge abutments
- Completing relocation of water main currently attached to the superstructure of the existing bridge
- Relocation of utilities that are interfacing with the proposed widening area on the northbound lanes of the proposal
- Relocation of utilities interfacing with shared path at the northern end of the proposal.

Stage 4 works include:

- Installation of traffic barriers to facilitate works mainly along the northbound shoulder around the new northbound bridge. Southbound traffic would remain as per Stage 3 and northbound traffic would utilise the new pavement on the completed bridge
- Construction of pavement widening along northbound shoulder at the new bridge
- Demobilisation and removal of temporary crane pads and / or work platforms
- Demolition of old bridge (potentially requiring installation of temporary cofferdams to remove bridge piles which would be removed once the bridge demolition is completed)

- Installation of road furniture
- Line marking
- Protection of existing buried utilities crossings Ironbark Creek western of existing bridge during its demolition
- Protection of overhead utility crossings to be retained
- Completion of utilities relocations and protections
- Landscaping and signage installation
- Rehabilitation of areas impacted by the proposal and demobilisation of construction compounds.

Stage 5 works include:

- Replacement of concrete slabs at the northern end of the proposal in multiple sub stages under night works
- Stage 5 night works can be constructed in parallel with works proposed in stages 1, 2, 3 and 4.

Stage 6 works include:

- This stage comprises mill and re-sheet new asphalt. and new asphalt overlays. This work would be completed in multiple sub stages under night works
- Diamond grinding and joint resealing of concrete pavement.

During all six stages a minimum of two lanes in each direction to be maintained, there would be a reduction in speed limit from 80 kilometres per hour to 60 kilometres per hour due to reduced lane widths, and temporary pavement markings and signage will be implemented.

5.1.3 Workforce and construction work hours

The size and arrangement of the construction workforce is expected to fluctuate throughout the construction of the project. The workforce would be dependent on the number of available road widening sections that can be undertaken, and it is envisaged that the project would be completed in sections and zones. It is expected that a single road works crew would typically consist of 10 to 20 personnel and the bridge works crew would typically consist of 10 to 30 personnel.

Standard construction hours for the proposal are outlined in **Table 5.1**

Table 5.1 Standard Construction Working Hours

Work Type	Typical CoA Construction Noise and Vibration standard hours of work	TfNSW Construction Noise and Vibration Guideline recommended standard hours of work
Standard Construction	Monday to Friday: 7am to 6pm inclusive Saturday: 8am to 6pm Sunday and Public Holidays: No Work	Monday to Friday: 7am to 6pm Saturday: 8am to 1pm Sunday and Public Holidays: No Work
Construction activities with impulsive or tonal noise emissions	Monday to Friday: 8am to 5pm Saturday: 8am to 1pm; and if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour.	Monday to Friday: 8am to 5pm[1] Saturday: 9am to 1pm[1] Sunday and Public Holidays: No Work

[1] Works may be carried out in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. 'Continuous' includes any period during which there is less than a one-hour respite between ceasing and recommencing any of the work the subject of this condition.

Construction of the proposal would occur during standard construction hours where possible. In accordance with NSW *Interim Construction Noise Guideline*, it may be proposed to extend the standard construction hours for this major public infrastructure project in order to:

- Entail less disruption to motorists with reduced volume of construction traffic during peak hours due to construction staff and some construction vehicles travelling to the construction site outside peak traffic periods
- Potentially result in a shorter overall construction duration
- Provide a safer road and shared user network earlier than planned
- Enable greater flexibility in project scheduling to potentially limit required weekend construction work.

As a large part of the proposal would occur within the existing road corridor, to ensure the health and safety of the public and construction crews and to minimise disruption to existing traffic flows, certain activities would need to take place during the extended construction work hours shown in **Table 5.2**.

Table 5.2 Extended Construction Working Hours

Work Type	**Typical CoA Construction Noise and Vibration standard hours of work**
Extended Construction Working Hours	Monday to Friday: 6am to 7pm Saturday: 7am to 5pm Sunday and Public Holidays: No Work

Providing longer hours for construction allows for flexibility in the programming of works to capitalise on dry periods and thereby maximising construction on the floodplain. This approach reduces the impact on the existing road network during busy weekday periods by scheduling additional work on weekends. Construction actives that are likely to occur in Out of Hours Work include, early works and utilities, pavement works, finishing works and compound activities.

Throughout the proposal certain activities would be required to be undertaken during the evening and night time periods. In these instances, the Contractor would work together with TfNSW to minimise out of hours construction activities. Measures would be implemented in accordance with an approved project specific Construction Environmental Management Plan (CEMP) to minimise noise and other types of disturbances to surrounding residents, businesses and road users. Out-of-hours works would be undertaken in accordance with TfNSW Environmental Noise Management Manual (2001), NSW Interim Construction Noise Guideline and an approved site-specific CEMP.

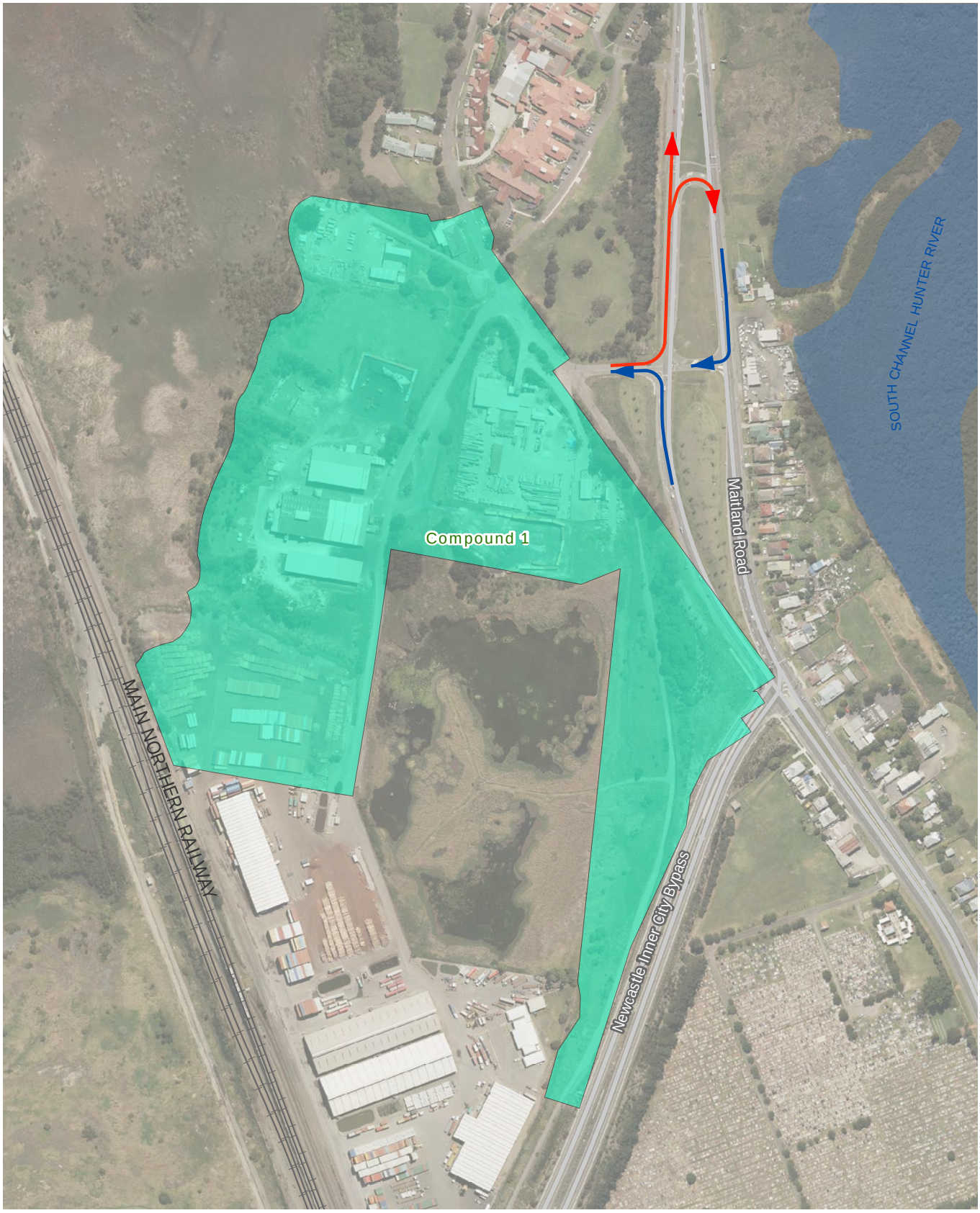
5.1.4 Location and access of construction ancillary facilities, including site compounds and stockpile sites

Four construction ancillary facility locations have been identified along the length of the proposal (**Figure 5.1**) and potential functions (including indicative construction worker parking locations) have been indicated in **Figure 1.2**. For this assessment, it is assumed that all ancillary facilities would be used for construction purposes. This assessment is conservative as it is not expected that all sites would always be functioning during the construction period.

Access to the construction ancillary facilities for delivery vehicles and staff are summarised in **Table 5.4.** Access points at each of the construction ancillary facilities frontages would be provided with adequate sight distances relating to the posted speed limit. This would allow vehicles on the road network to see vehicles exiting from the construction ancillary facilities and would allow sufficient room to slow down and stop if necessary. This approach would also provide vehicles waiting to exit from the construction ancillary facilities with adequate sight distance to see approaching vehicles and determine acceptable gaps. It should be noted that construction ancillary facilities are generally connected, which would mean that construction traffic movements may fluctuate as they move between sites internally.

Table 5.3 Ancillary facilities functions and activities

Compound site	Location	Approximate size (ha)	Purpose
C1	Sandgate - Supports construction works for the southern portion of the proposal, including bridgeworks at Ironbark Creek	19	Potentially the main site compound for the proposal; likely to include: ▪ Plant servicing workshop ▪ Stockpile and laydown area ▪ Amenities ▪ Vehicular access car park
C2	Hexham - Supports construction works for the central portion of the proposal	39	Potentially the main site compound for the proposal; likely to include: ▪ Plant servicing workshop ▪ Stockpile ▪ Laydown area ▪ Amenities ▪ Vehicular access car park ▪ Potentially bridge support
C3	Hexham - Supports construction works at the A1 Pacific Highway and Maitland Road intersection and north of Hexham Bridge	8.7	▪ Secondary/support offices ▪ Amenities ▪ Vehicular access car park
C4	Hexham - Supports construction works north of Hexham Bridge	1.9	▪ Secondary/support offices ▪ Amenities ▪ Vehicular access car park



Legend

- Construction compound/ Ancillary facility
- Railway
- Road
- Waterway
- Access Route
- Departure Route

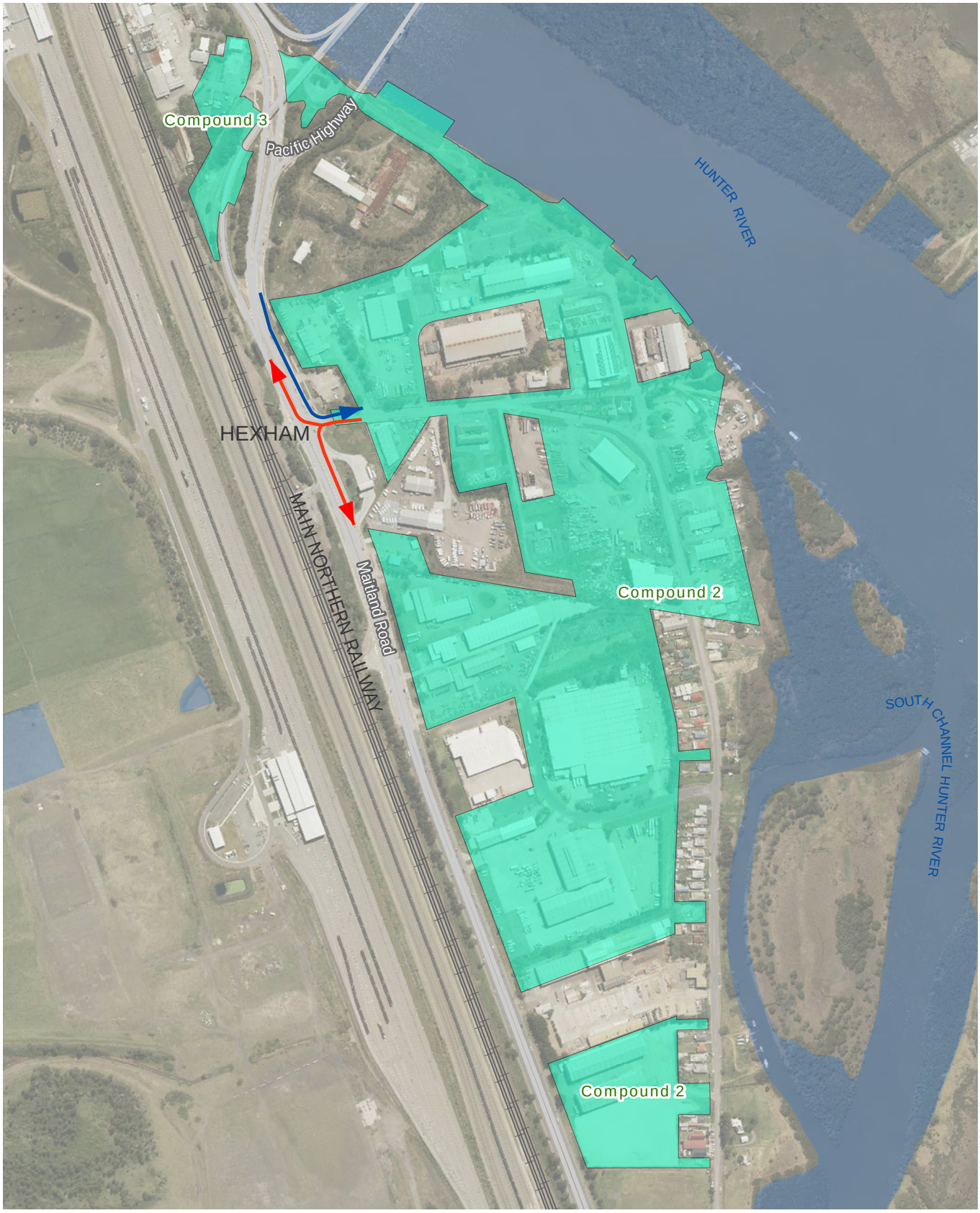
75 0 75 m

Scale 1:5,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.1a Ancillary facilities access and departure



Legend

- Construction compound/ Ancillary facility
- Railway
- Road
- Waterway
- Access Route
- Departure Route

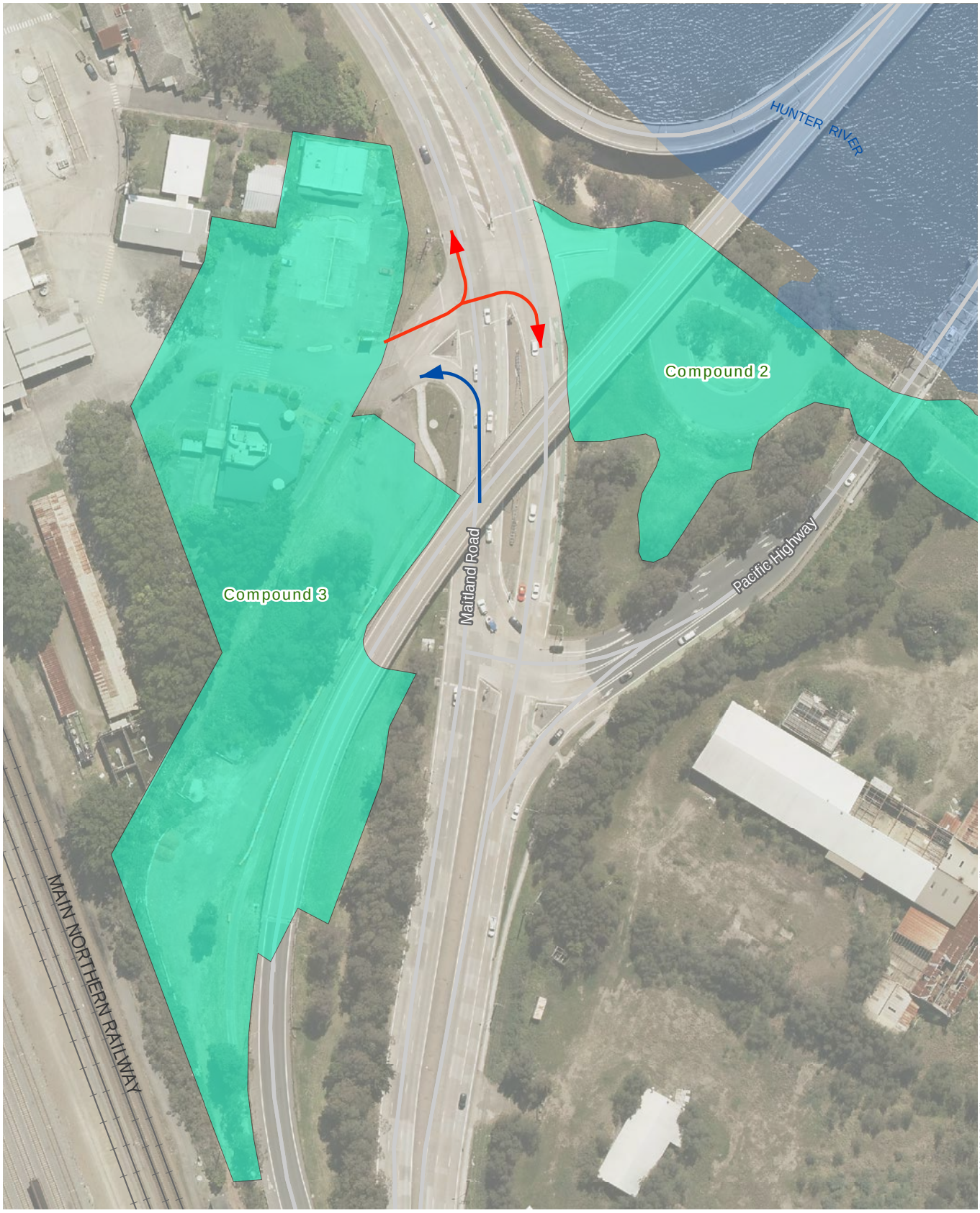
100 0 100 m

Scale 1:7,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.1b Ancillary facilities access and departure



Legend

- Construction compound/ Ancillary facility
- Railway
- Road
- Waterway
- Access Route
- Departure Route

20 0 20 m

Scale 1:1,500 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Date: 12/11/2021 Filename: IA301100_TRF_F017_AncillaryFacilityAccess_v1

Figure 5.1c Ancillary facilities access and departure

Hexham Straight Widening

Legend

- Construction compound/ Ancillary facility
- Railway
- Road
- Waterway
- Access Route
- Departure Route

20 0 20 m

Scale 1:1,500 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Date: 12/11/2021 Filename: IA301100_TRF_F017_AncillaryFacilityAccess_v1

Figure 5.1d Ancillary facilities access and departure

Table 5.4 Construction ancillary facilities access details

Compound site	Direct entry access	Direct exit access	Indicative traffic movements to arrive at site	Indicative traffic movements leaving site
C1	Straight in from Old Maitland Road (North of NICB), Sandgate	Straight out to Old Maitland Road (north of NICB), Sandgate	▪ Southbound vehicles on Maitland Road would need to turn right at the U-Turn provision at Old Maitland Road (north of NICB) and continue through to the site ▪ Northbound vehicles would need to turn left using the slip lane onto Old Maitland Road (north of NICB)	▪ Vehicles would need to exit site by heading northbound on Maitland Road via a left turn from Old Maitland Road (north of NICB) ▪ Vehicles wanting to head south could turn around at the U-turn provision 160 m north of Old Maitland Road (north of NICB and opposite the Calvary St Joseph's Retirement Community).
C2	Northern access: Straight in from Old Maitland Road (north), Hexham OR Southern access: Straight in from Old Maitland Road (south), Hexham	Northern access: Straight out from Old Maitland Road (north), Hexham OR Southern access: Straight out from Old Maitland Road, Hexham	▪ Northern access - Southbound vehicles on Maitland Road can enter the site by turning left at the signalised intersection at Old Maitland Road ▪ Southern access - Southbound and northbound vehicles on Maitland Road can enter the site by turning left or right respectively at the signalised intersection at Old Maitland Road	▪ At the northern exit, vehicles can exit the site and head either in either direction on Maitland Road at the Old Maitland Road intersection with Maitland Road ▪ At the southern exit, vehicles can exit the site only turn left to travel in the southbound direction on Maitland Road. Vehicles travelling north are to use the northern exit
C3	Left in from northbound Maitland Road at the A1 Pacific Highway and Maitland Road intersection	Straight out to Maitland Road near the Oak Factory industrial area	▪ Vehicles would need to enter the site from the northbound carriageway of Maitland Road ▪ Southbound vehicles could turn right at the signalised intersection of Maitland Road and the Oak Factory access road to access the southern section of the compound site. To access the northern section vehicles could then do a	▪ Vehicles can exit the southern section of the site and head in either direction on Maitland Road at the signalised intersection of Maitland Road and the Oak Factory access road. ▪ At the northern end of the construction compound, traffic can only exit and head north but can use the turning provision at the northern

Compound site	Direct entry access	Direct exit access	Indicative traffic movements to arrive at site	Indicative traffic movements leaving site
			U-turn to the south of the access road or can use the dedicated U-turn facility underneath the A1 Pacific Highway opposite the access road into the Oak Factory	end of the proposal to head south.
C4	Left in from southbound Maitland Road just to the north of the southbound exit to the A1 Pacific Highway	Left out to southbound Maitland Road just to the north of the southbound exit to the A1 Pacific Highway	▪ Vehicles would need to enter the site southbound on Maitland Road ▪ Northbound vehicles could turn around at the turning provision at the U-Turn bay at the compound site's entrance	▪ Vehicles would need to exit site by heading south-east on Maitland Road ▪ Vehicles wanting to head north-west would need to travel about 400 m southbound on Maitland Road and turn left at the signalised intersection located underneath the entrance ramp of the A1 Pacific Highway opposite the access road into the Oak Factory where there is a dedicated U-turn facility to turn around before heading north.

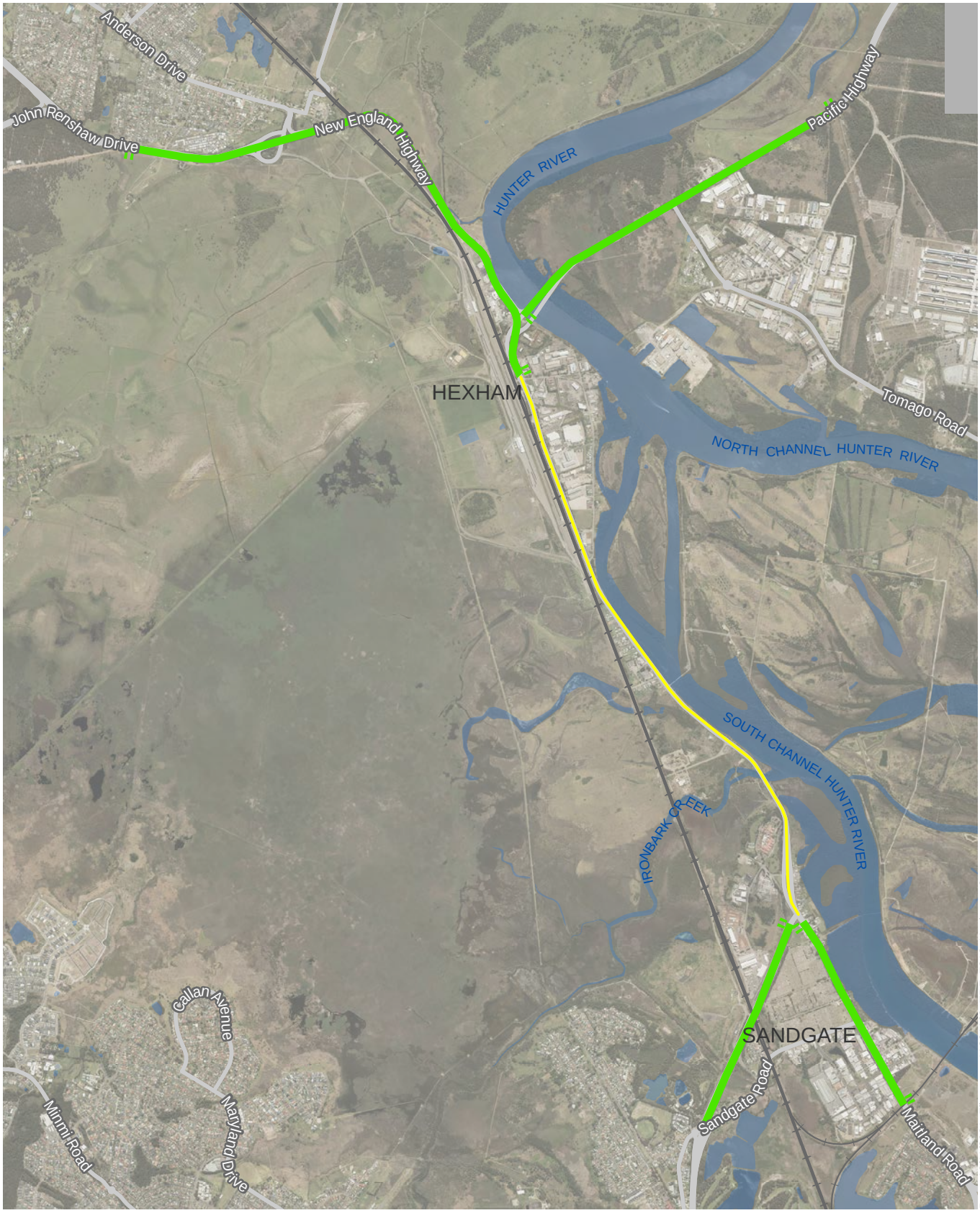
5.1.5 Haulage routes and use of the existing road network

The main increase in vehicle movements on the existing road network would arise from the transportation of the following materials required during construction of the proposal:

- Earthworks materials, such as topsoil, general fill material, select fill for use in the Selected Material Zone (SMZ) and verge, bridging layers and drainage layers
- Aggregates for drainage construction, concrete and asphalt production and spray seals
- Sand for drainage construction and concrete and asphalt production
- Concrete for drainage construction, pavement construction, bridgeworks and miscellaneous works such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Bitumen for spray seals and asphalt production
- Cement and fly ash for concrete production
- Road base for the construction of flexible pavements
- Precast concrete elements for drainage construction (culverts, pits and headwalls) and miscellaneous works
- Steel for barrier railings and reinforcement in concrete.

Where possible, materials for the proposal would be sourced from local suppliers. The roads which are expected to be used for haulage routes are shown in **Figure 5.2**. Heavy machinery would need to be transported to and from site during off peak hours to minimise road user delays due to turning movements. Oversize and overmass vehicles are likely to be escorted and travel at slower speeds than other vehicles on the existing road network.

Construction haulage routes would use Maitland Road to the north and south of the proposal, the A1 Pacific Highway to the east of the proposal or the A37 Newcastle Inner City Bypass to the south-west of the proposal (refer to **Figure 5.2**). These major highways are sufficient to cater for heavy construction vehicles without imparting significant road user delay to other vehicles. Vehicles would transport materials to the four construction ancillary facilities identified in **Figure 1.2**.



Date: 12/11/2021 Filename: IA301100_TRF_F012_Haulage_v2

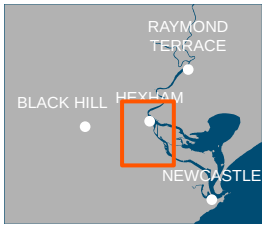
Legend

- Haulage route
- Pacific Highway/Maitland Road (A43) Study Corridor
- Railway
- Waterway

0 1 1 km

Scale 1:40,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.2 Haulage routes

Hexham Straight Widening

5.1.6 Impact on traffic

Construction traffic movements

Construction related traffic would use the surrounding road network to:

- Provide access for the workforce to the ancillary sites and construction access locations
- Haul construction related materials to and from the construction access locations
- Carry equipment and materials from one area of the construction site to another.

Based on the information shown in **Table 5.5**, the daily traffic movements anticipated at each of the construction ancillary facilities and construction access locations show that there are about 400 daily vehicle in and out movements expected as part of construction activities. This includes about 300 daily heavy vehicle movements and 106 construction workforce (light vehicle) movements. On average there are about 30 heavy vehicle movements and 10 construction workforce (light vehicle) in and out movements during the peak hour across the four ancillary facilities. While no construction vehicle movements have been estimated for out-of-hours work, they are anticipated to be below the peak hour movement numbers listed in **Table 5.5**.

When compared to traffic volumes along Maitland Road without construction, additional traffic volumes generated are relatively minor. Therefore, additional traffic movements are anticipated to have negligible impacts to the usability on this transport corridor. Adverse traffic conditions are expected to be more greatly impacted by lane closures and a reduction of the posted speed limit

Table 5.5 Daily construction traffic movements

Location reference	Additional vehicle movements				Existing traffic volume			
	Heavy vehicles	Light vehicles	Total vehicles	Peak hour total vehicles	Heavy vehicles	Light vehicles	Total vehicles	Peak hour total vehicles
C1	121	42	162	16	8,520	41,580	50,100	4,600
C2	91	32	122	12	8,520	41,580	50,100	4,600
C3	45	16	61	6	9,420	45,980	55,400	4,200
C4	45	16	61	6	9,420	45,980	55,400	4,200
Total	**302**	**106**	**406**	**40**				

5.1.7 REF area construction impacts

Road network performance

To quantify the impact upon traffic conditions on the existing road network that arise from construction activities, traffic modelling was undertaken using VISSIM to compare construction traffic models to a future base model in 2025. The models assessed a worst-case scenario, with two lanes operational in each direction throughout the construction corridor and a reduced speed limit of 60 kilometres per hour in both the morning peak and evening peak traffic conditions. A cross section of the modelled road network is shown in **Figure 5.3.** Travel time results from the VISSIM base model and the construction model shown below in **Table 5.6** and **Table 5.7**.

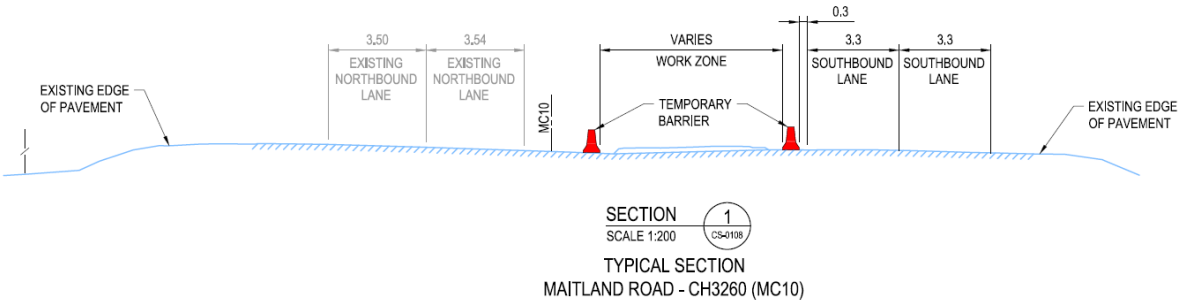


Figure 5.3 Cross-section of the road during construction

Table 5.6 Travel time comparison during the morning peak in minutes

Direction	The modelled route along Hexham Straight	Distance (km)	Future Base 2025	Construction Phase 2025
			8-9am	8-9am
Southbound	660m north of Hexham Bridge to Old Maitland Road (south) intersection	2.43	06:06	05:49
	Old Maitland Road (south) intersection to Sparke Street intersection	1.69	02:03	02:12
	Sparke Street intersection to 290m south of Newcastle Inner City Bypass intersection	1.79	01:40	01:52
	Full modelled construction route	**5.91**	**09:40**	**09:47**
Northbound	290m south of Newcastle Inner City Bypass intersection to Sparke Street Intersection	1.77	02:15	02:32
	Sparke Street intersection to Old Maitland Road (south) intersection	1.70	01:54	02:15
	Old Maitland Road (south) intersection to 660m north of Hexham Bridge	2.42	02:31	02:47
	Full modelled construction route	**5.90**	**06:41**	**07:31**

	Reduced in journey time >5%		journey time change < 5%		Increase in journey time > 5%

Table 5.7 Travel time comparison during the evening peak in minutes

Direction	The modelled route along Hexham Straight	Distance (km)	Future Base 2025	Construction Phase 2025
			5-6pm	5-6pm
Southbound	660m north of Hexham Bridge to Old Maitland Road (south) intersection	2.43	04:33	03:44
	Old Maitland Road (south) intersection to Sparke Street intersection	1.69	01:40	02:01
	Sparke Street intersection to 290m south of Newcastle Inner City Bypass intersection	1.79	01:36	01:49
	Full modelled construction route	**5.91**	**07:48**	**07:36**
Northbound	290m south of Newcastle Inner City Bypass intersection to Sparke Street Intersection	1.77	03:15	06:08
	Sparke Street Intersection to Old Maitland Road (south) Intersection	1.70	02:01	04:14
	Old Maitland Road (south) intersection to 660m north of Hexham Bridge	2.42	03:31	04:51
	Full modelled construction route	**5.90**	**08:52**	**15:38**

Reduced in journey time >5% | journey time change < 5% | Increase in journey time > 5%

Travel time results indicate delays are to be expected under worst-case scenarios developed when compared to future base conditions in 2025. The impacts are most notable in the northbound direction in the evening peak traffic period, with the reduction from three lanes to two at the southern approach to the A1 Pacific Highway and Maitland Road intersection is the most significant cause of potential delays. The construction phase results display a travel time improvement for a segment of the southbound carriageway due to the reduction in lanes for construction that removes any three lanes to two merging issues. However, vehicles experience increased delays at the approach to the construction zone, which is not captured in this analysis. Vehicles may be able to travel this portion of the corridor quicker in the construction phase, they would experience lengthier delays at the approach to Hexham Straight. In the southbound direction in the evening peak and both directions during the morning peak, expected travel time delays across the extent of the proposal are within 60 seconds.

Impact on property access

Maitland Road remains open in both directions during the extent of construction works and all movements are continually provided for. Existing pedestrian access to residential and commercial properties fronting the Maitland Road would be maintained throughout the construction works. All major movements at key intersections would be maintained. Some minor impacts to breaks in the median at Fenwick Street, Millams Road (Ash Island Bridge and Hunter Wetlands National Park) and at the access to Gilbert & Roach would occur during construction.

Access to properties near the proposal would be maintained during construction, although temporary access changes may be required for some properties that have a frontage to Maitland Road. Alteration to access arrangements is likely to be required during pavement widening works being undertaken immediately in front of a driveway. This would be for a duration of one shift. Where possible, pavement widening works being undertaken immediately in front of a driveway would be completed outside of business hours to minimise

impacts. In addition, local residents and businesses will be consulted prior to the commencement of the works and will be kept informed of the construction progress works and alternative routes to minimise any impacts. Traffic control personnel will be in attendance at the working area to assist with local access and egress throughout the construction works.

The construction contractor will be required to develop a construction TMP detailing controls to be implemented to minimise the impacts of construction. The plan will need to be developed in conjunction with approving authorities, including emergency and utility services.

Impact on public transport

Interaction with rail infrastructure and services

There would be minimal impact on the function of the Main North Rail Line and Hexham train support facility during the proposal's construction. Access to Hexham Railway Station and ARTC assets via Maitland Road would be affected by road closures during the concrete and asphalt placement for road surfacing required in Stage Two (works on western shoulders) of the construction program, however, temporary measures will be adopted by the construction contractor to provide alternative commuter access points. Where this is not possible, activities would need to take place during evening and night-time periods ('out-of-hours work') to minimise disruption to rail users.

Bus services

Construction staging of works ensures movements are enabled in both directions along Maitland Road, therefore there would not be an impact on any of the bus routes undertaken by current local and public bus services. However, impacts to travel time and the travel reductions outlined under 'Road network performance' are also valid for buses which would be impacted by:

- Adverse traffic conditions arising from lane closures required to complete staged works
- Additional vehicle movements to transport materials to site
- A reduction of the posted speed limit from 80 kilometres per hour to 60 kilometres per hour.

Access to existing bus stops would be temporarily impacted during the concrete and asphalt placement for road surfacing required during construction. If bus stops are required to be relocated to maintain access, bus stops would be located as close as possible to the original bus stop locations, and pathways would be provided. Consultation would be carried out with the affected bus operators during detailed design.

Impact on freight

Construction staging of the works ensures movements are enabled in both directions along Maitland Road, including heavy vehicle movements. Freight vehicles can maintain use of this major transport corridor, however, the travel reductions outlined in **Table 5.6** and **Table 5.7** are also valid for freight vehicles. Overall, the provision of traffic management measures is expected to minimise the impact on the freight network.

Roadworks are not expected to impact rail freight operations on the Main North Rail Line, with road access to loading areas maintained throughout staged works and no temporary closures of rail operations required.

Impact on the bicycle network

During construction, access would be maintained for cyclists and pedestrians in both direction.

Impacts on the bicycle network are likely to occur at some stages during the construction of the proposal where alternate lanes are set up to facilitate traffic movements. Where possible, cyclist movements within the

proposal work areas would be avoided where possible and a 1.5-metre-wide shoulder would be maintained during construction.

Where cyclists are required to move through construction work zones, temporary measures will be adopted by the construction contractor to minimise construction impacts including the provision of facilities such as bridges and ramps to separate cyclists from the proposed construction works to maintain safety. The provision of traffic control staff during construction hours to manage cyclist movements through the construction site may also be mandated during all stages of construction.

If the above is not possible or construction works during these stages requires closure of cyclist paths, safe detours for cyclists would be nominated to maintain cyclist movements.

Impact on the pedestrian network

Impacts on the pedestrian network is likely to occur during construction of the proposal where alternate lanes are set up to facilitate traffic movements. Where construction activities impact pedestrian movements, temporary measures must be adopted by the construction contractor to minimise impacts including the provision of facilities such as bridges and ramps to separate pedestrians from proposed works and maintain safety. The provision of traffic control staff during construction hours to manage pedestrian movements through the construction site may also be mandated during all stages of construction.

Impact on the maritime network

Although the proposal involves the replacement of the bridge which spans Ironbark Creek with new twin bridges, impact to maritime operations from the construction of the proposal is expected to be negligible, as there is no major maritime traffic along Ironbark Creek aside for some occasional recreational vessels.

5.1.8 EIS area construction impacts

The EIS area only assesses impacts of the overall program of works within land subject to the CM SEPP, and as shown in **Figure 1.3**, the extent of construction works on these areas is minimal. Access would be required at small locations located to the north and south of Ironbark Creek on the eastern side of Maitland Road to enable road pavement, earthworks (embankment) and construction of piers to support the new bridge over Ironbark Creek. Local access to informal fishing spots near Ironbark Creek would be removed during construction.

Impact on traffic

Traffic impacts would be limited in the EIS area and would include the temporary use of access roads during construction to enable road pavement, earthworks (embankment) and construction of piers to support the new bridge over Ironbark Creek. Construction traffic would be required to access these temporary construction roads from Maitland Road during construction and will include access into and out of these areas by trucks and construction plant . There will be no impacts to traffic in the EIS area during construction as this area will only be used by construction vehicles.

Impact on property access

Access to the crown land south east of the Ironbark Creek Bridge would be restricted during construction as part of the proposal. A small informal pullover area on the northern side of the bridge directly opposite to Sparke Street would also be impacted during the construction. No other impacts to property access during construction were identified within the EIS area.

Impact on public transport

The bus stop located on the southbound carriage way of Maitland Road at the intersection of Maitland Road and Shamrock Street would be impacted and is required to be relocated due to construction . As outlined in **Section 5.3.2** the relocation would be permanent to provide improved pedestrian connectivity. Access to the bus stop would be maintained during construction. Consultation would be carried out with the affected bus operators during detailed design.

Impact on freight

No impacts to rail were identified within the EIS area.

Impact on the cyclist network

No impacts to cyclist were identified within the EIS area.

Impact on the pedestrian network

No impacts to pedestrians were identified within the EIS area.

Impact on the maritime network

No impacts to maritime traffic were identified within the EIS area.

5.2 Operation impacts

This section provides an assessment of the operational performance of the proposal and the impact on the traffic and transport network. This section assesses the most congested hour during the morning and evening peak, which are 8-9am for the morning and 5-6pm for the evening peak. The full three hour morning and evening peak model results are presented in **Attachment B**.

5.3 REF area operation impacts

5.3.1 Road network performance

Traffic volumes

Modelled daily traffic volumes for the various scenarios are presented in **Figure 5.4**. The figure shows the morning peak (8-9am), evening peak (5-6pm) and daily traffic for 2028, 2038 and 2048. Daily traffic volumes have been extrapolated from the peak hours. The volumes have been extracted from the 'with proposal' traffic model and display the increase in traffic volumes that occur due to the proposed road upgrades.

Analysis of the modelled traffic flows shows the following key differences throughout the network:

- The evening peak period experiences a greater increase in traffic volumes along the proposal in each of the modelled years when compared to the morning peak. This is most evident in 2028 where the morning peak flow increases by about two per cent, while the evening peak flow increases by about 10 per cent. The difference between these two outcomes is due to the levels of unreleased trips in the 'do minimum' model. The evening peak has a greater number of unreleased trips, particularly at the southern approach to Maitland Road, thus the widening of Hexham Straight increases the capacity, releasing additional trips. The morning peak has lower levels of unreleased trips, therefore the increase in traffic volumes is more modest when compared to the evening peak

- In 2038 the traffic volume on Maitland Road increases by about 15 per cent in the morning peak and 25 per cent in the evening peak. In 2048, the increase in traffic volumes is about 25 per cent in the morning peak and 30 per cent in the evening peak
- The proposal would also lead to an increase in traffic volumes on the Newcastle Inner City Bypass and the A1 Pacific Highway east of Hexham Bridge. These increases are a result of increased capacity at the A1 Pacific Highway and Maitland Road intersection and the Newcastle Inner City Bypass and Maitland Road intersection
- The proposal would provide greater capacity on the Hexham Straight corridor allowing more vehicles to pass through the corridor. The increased capacity would provide for an additional 3 per cent of vehicles in 2028, 29 per cent of vehicles in 2038 and 35 per cent of vehicles in 2048.

Overall, the proposal provides greater capacity for northbound and southbound traffic which would lead to an increase in traffic volumes along the proposal during the peak periods.

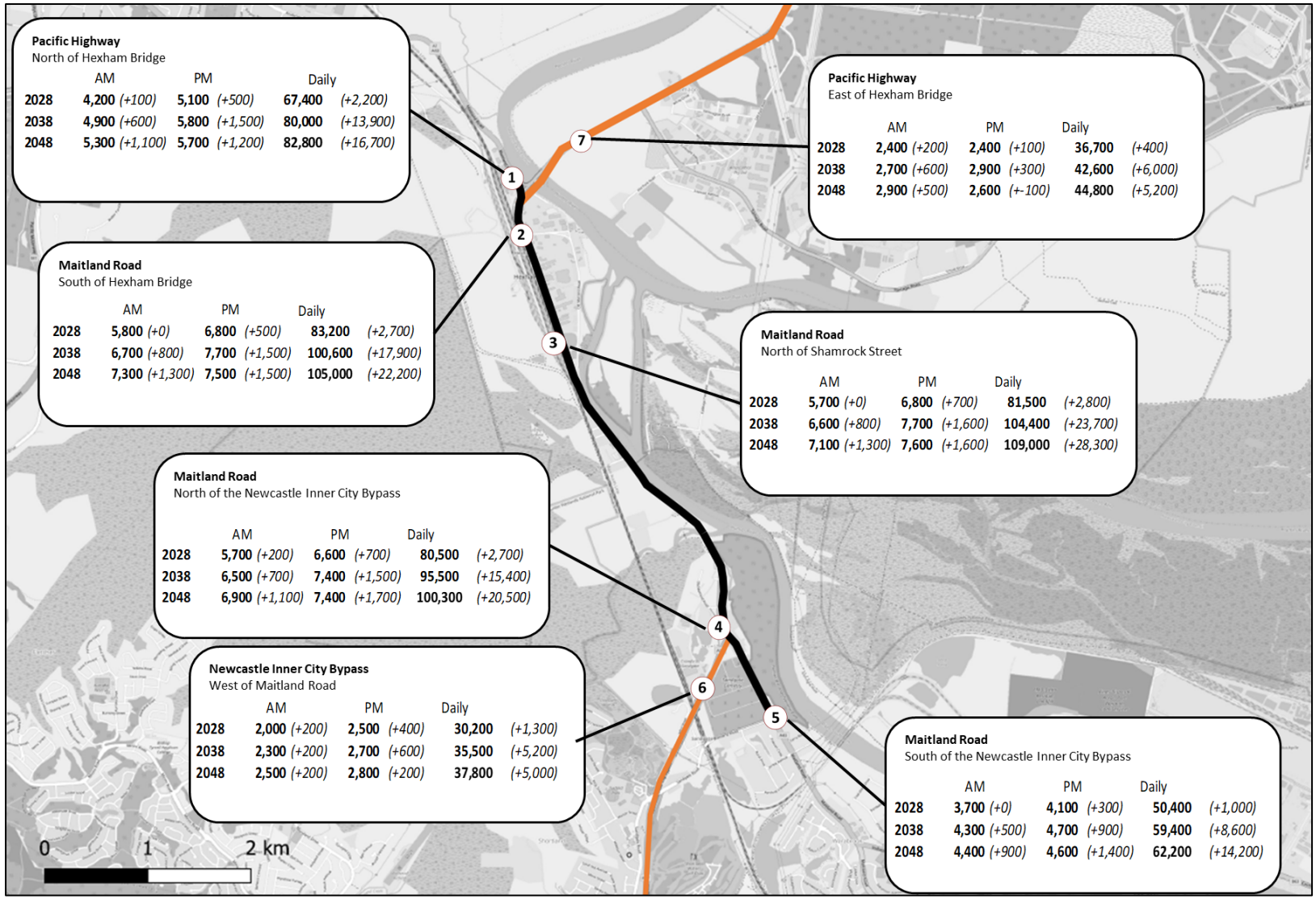


Figure 5.4 Traffic volumes – with proposal

Changes in traffic flow patterns due to the proposal

Results from modelling the existing traffic flow conditions in the do minimum traffic model and traffic condition with the implementation of the proposal in the model show that the proposal leads to a change in traffic flow conditions along Maitland Road. In the do minimum traffic model, southbound vehicles merge from three lanes to two lanes in the northern section of the model on Maitland Road, to the south of Old Maitland Road (north) in Hexham. In future years, this creates a queue of vehicles travelling southbound, queuing back to and past the A1 Pacific Highway and Maitland Road intersection. South of the merge point on Maitland Road, traffic is relatively free-flowing as throughput is limited by the merge. This section of Maitland Road is identified as the Old Maitland Road (north) pinch point. With the implementation of the proposal, three lanes would be maintained in the southbound direction, and there would be no merge point at this location, effectively removing the Old Maitland Road (north) pinch point from this section of the road network. The changes in traffic flow at the northern end of the proposal as modelled in the do minimum traffic model and with the proposal model are shown in **Figure 5.5**.

As traffic continues south further changes in traffic flow occur in the proposal model, to the south of the Newcastle Inner City Bypass where Maitland Road returns to two lanes. Due to the increased traffic that is released from the removal of the Old Maitland Road (north) pinch point, the traffic signals at the Wallsend Road and Maitland Road intersection creates a new pinch point that causes traffic to flow back through the road network. This pinch point impacts the Newcastle Inner City Bypass and Maitland Road intersection, the Sparke Street and Maitland Road intersection, and the Shamrock Road and Maitland Road intersection and is shown in **Figure 5.6** and **Figure 5.7**.

The traffic model results presented within this chapter should be considered collectively, as traffic volumes, travel times and intersection delays are all interrelated. In addition, the change in traffic flow patterns is only expected to occur during peak periods when the road network is close to its capacity. While not modelled, it is anticipated that during off-peak periods this new pinch point would not impact traffic flow on the corridor.

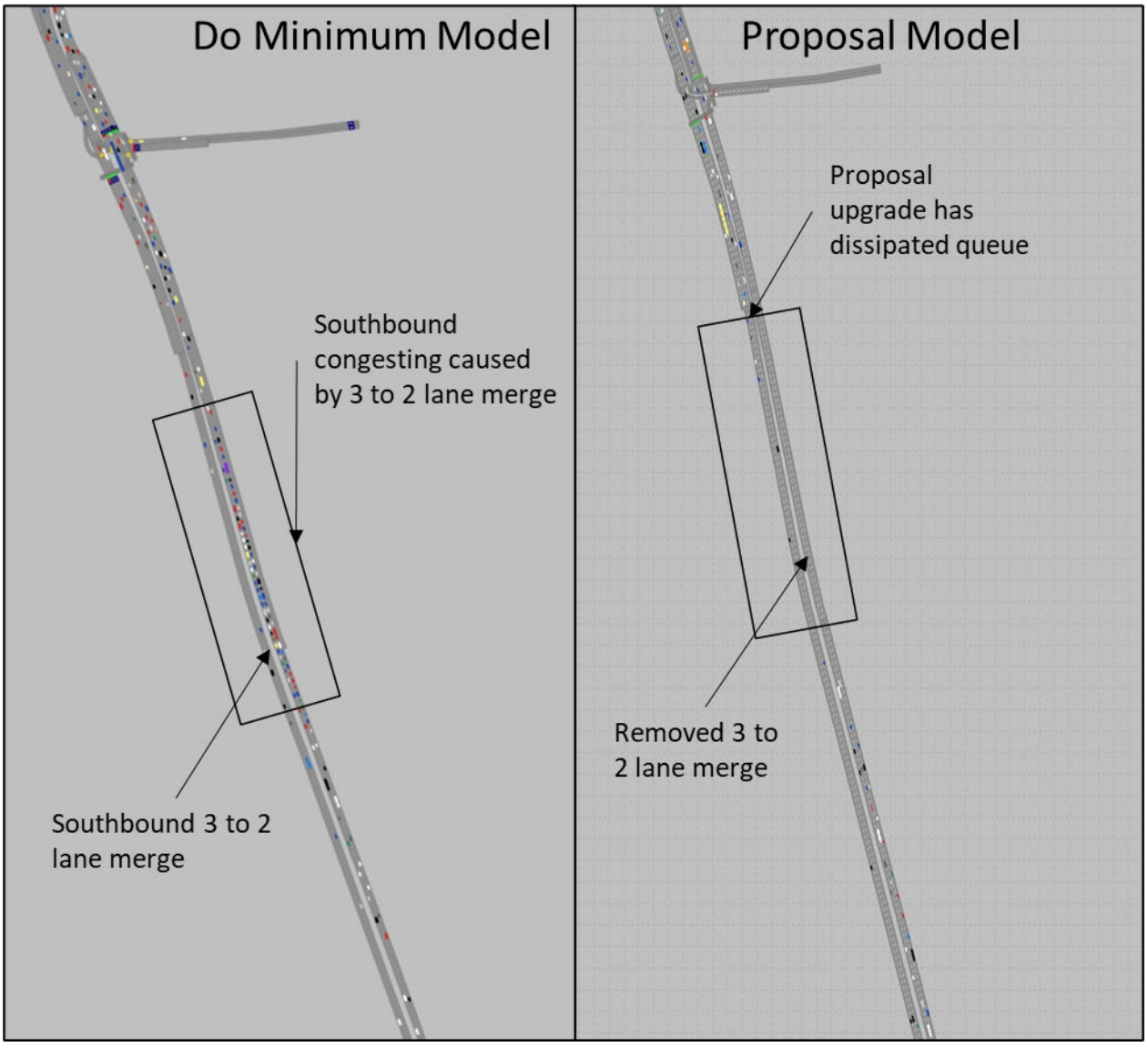


Figure 5.5 Comparison of traffic at the southbound merge just south of Old Maitland Road (north) in the 2048 AM peak

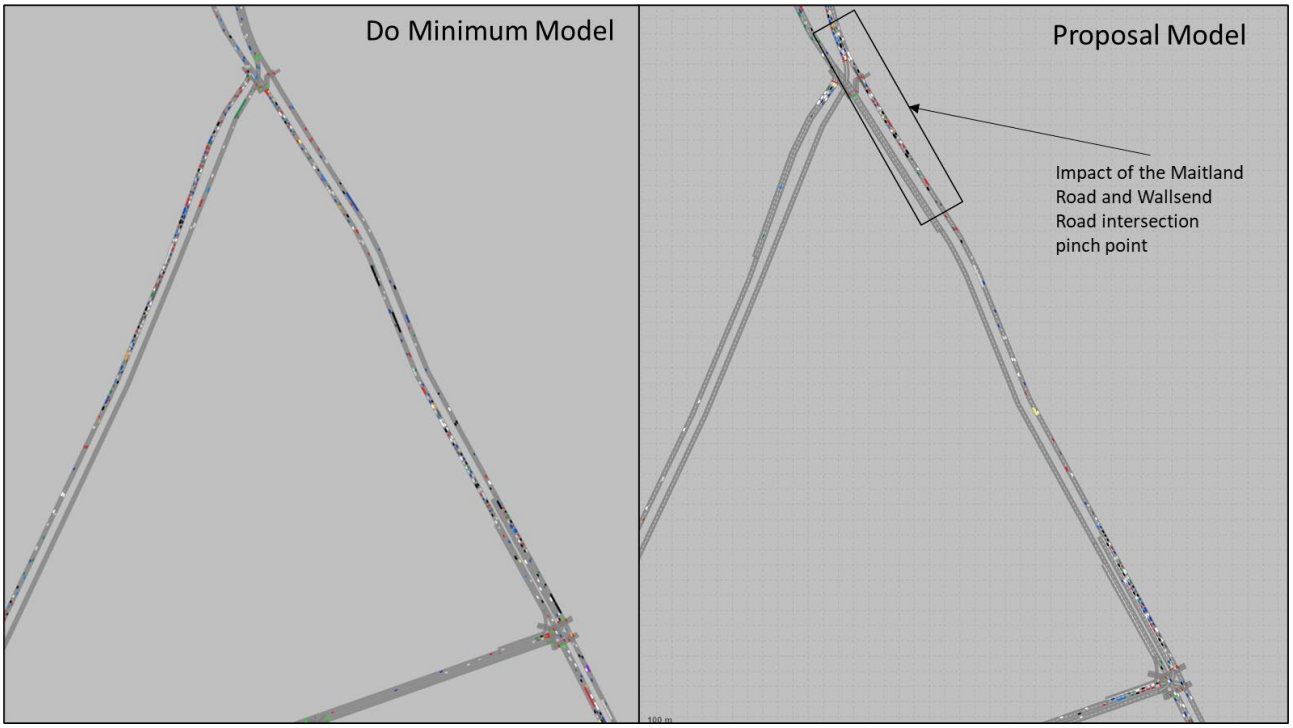


Figure 5.6 Comparison of traffic just south of the Newcastle Inner City Bypass in the 2048 AM peak

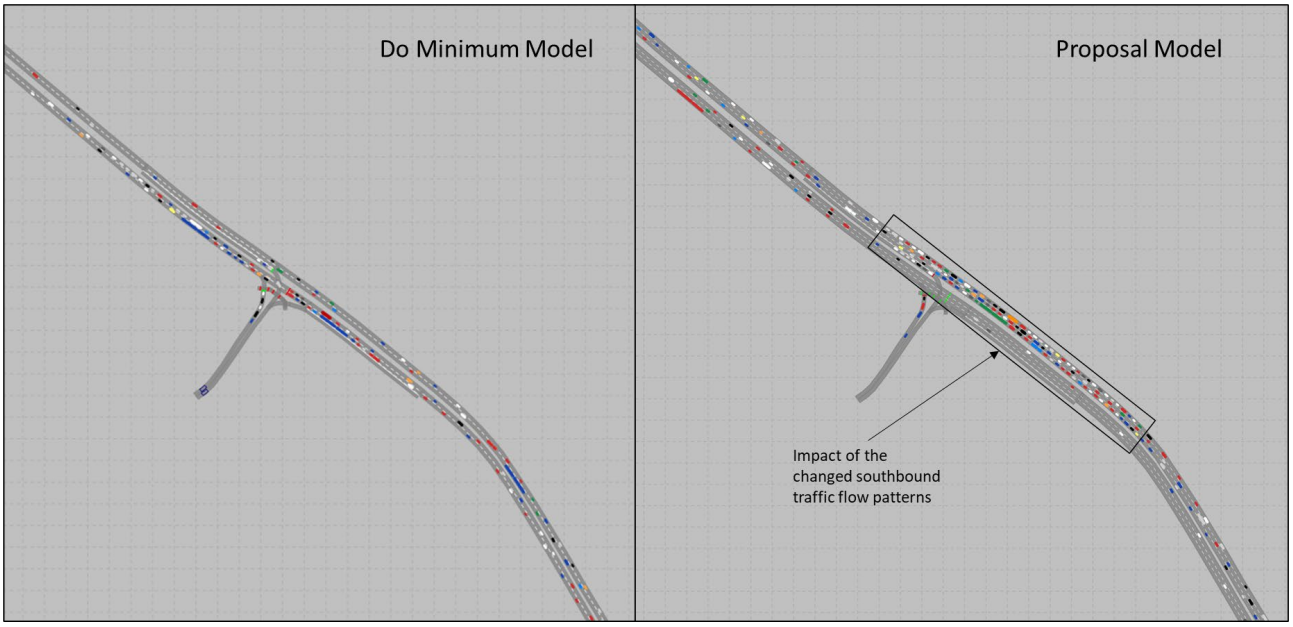


Figure 5.7 Comparison of southbound traffic at Sparke Street in the 2048 AM peak

Network statistics

A comparison of network statistics between the 'do minimum' and 'with proposal' scenarios are provided in **Table 5.8** for 2028, **Table 5.9** for 2038 and **Table 5.10** for 2048.

Comparison of the 'do minimum' and 'with proposal' scenarios for the 2028 horizon year shows the following:

- Substantial increase in average network speed, particularly during the evening peak period. Forecast average network speed is likely to increase by 13 per cent
- Minimal variance in VKT across the 'do minimum' and 'with proposal' options. However, there is a substantial reduction in VHT of up to 12 per cent. These improvements, coupled with the constant total throughput between the 'do minimum' and 'with proposal' models, indicate vehicles can complete the same quantity of trips but in a faster manner
- Substantial reduction in stops by up to 80 per cent, indicating traffic is smoother and not subject to flow breakdown, which means trips can complete their journey with less interruption.
- During the evening period, the latent demand has decreased by about 1,000 vehicles in the 'with proposal' model in comparison to the 'do minimum' model. All unreleased trips in 2028 are associated with the south approach at Maitland Road.

Table 5.8 2028 network statistics

Network statistic	2028 morning peak		2028 evening peak	
	Do minimum	With proposal	Do minimum	With proposal
Total throughput	42,187	42,933	46,742	48,078
VHT	8,558	7,530	9,629	8,702
VKT	482,785	485,787	522,185	535,372
Network speed (km/h)	57	65	54	62
Total stops	451,083	88,488	333,762	142,666
Latent demand	2	1	1,549	534

Comparison of the 'do minimum' and 'with proposal' scenarios for the 2038 horizon year shows the following:

- Substantial improvement in the operational performance of the road network is likely, up to an additional 9 per cent of vehicles can complete their trips within the modelled period. The forecasted average network speed is likely to increase by 12 per cent in the morning peak and 22 per cent in the evening peak
- VKT is likely to increase by up to 9 per cent due to more released traffic on the network compared to 'do minimum' and the proposal would likely lead to a substantial reduction in VHT of up to 14 per cent
- Substantial reduction in stops of up to 78 per cent, indicating traffic is smoother and not subject to flow breakdown, which means trips can complete their journey with less interruption.
- The 'with proposal' scenario would also relieve substantial congestion at the edge of the study area during the morning and evening peaks. Up to 2,300 vehicles, which previously were unable to enter the study area, can now enter as a result of network improvements that occur due to the proposal.

Table 5.9 2038 network statistics

Network statistic	2038 morning peak		2038 evening peak	
	Do minimum	With proposal	Do minimum	With proposal
Total throughput	46,194	50,481	52,796	55,939
VHT	12,055	10,867	15,117	13,103
VKT	535,374	584,407	591,989	645,481
Network speed (km/h)	48	54	41	49
Total stops	1,335,331	306,039	1,299,529	616,118
Latent demand	20	9	3,546	1,189

Comparison of the 'do minimum' and 'with proposal' scenarios for the 2048 horizon year shows the following:

- Substantial improvement in the operational performance of the road network is likely, particularly during the evening peak period. Forecast average network speed is likely to increase by up to 24 per cent in the peak periods
- VKT is likely to increase by up to 14 per cent due to more released traffic on the network compared to 'do minimum' and a substantial reduction in VHT of up to 20 per cent is anticipated
- Substantial reduction in stops of up to 71 per cent in the morning peak period, indicating traffic is free flowing and not subject to congestion, meaning trips can complete their journey with less interruption.
- In the 'Do minimum' models, latent demand significantly increase in 2048, which is evidence that the network cannot cater for the expected volumes without the proposal upgrades. While 'Do minimum' upgrades were implemented to reduce latent demand and provide a comparable network, this could not be significantly reduced without implementing the proposal itself. Overall, the proposals significantly reduces latent demand and improves throughput across the network, which is supporting the strategic need for the proposal
- The 'with proposal' scenario would also relieve congestion at the edge of the study area, with up to 40 per cent fewer vehicles waiting to enter the network at the edge of the model during the peak periods.

Table 5.10 2048 network statistics

Network statistic	2048 morning peak		2048 evening peak	
	Do minimum	With proposal	Do minimum	With proposal
Total throughput	48,161	53,408	54,147	58,281
Vehicle hours travel (VHT)	18,231	14,612	19,486	18,051
Vehicle kilometres travelled (VKT)	545,367	620,906	604,784	678,631
Network speed (km/h)	35	42	33	38
Total stops	3,041,822	916,940	3,127,789	1,747,518
Latent demand	6,402	2,090	11,646	4,721

Overall, the key network statistics demonstrate the proposal would provide positive outcomes for the performance of the road network in each of the modelled scenarios. The proposal results in a more efficient road network, that can cater to a higher volume of vehicles, while also maintaining faster travelling speeds for motorists.

Intersection performance

The operational performance at key intersections within the network is presented in **Table 5.11** to **Table 5.13** Cells with pink shading represents intersections where operations are worse than LoS D.

As outlined in **Section 3.5.3,** LoS D is the target performance level generally accepted. In circumstances where intersection performance falls below LoS D, investigations should be initiated to determine if suitable remediation can be provided. However, limited road capacity and high demand for the proposal mean that LoS E and LoS F are regularly experienced by motorists, particularly during peak periods.

Table 5.11 Performance of modelled intersections in 2028

Intersection	Type	2028 'do minimum'				2028 'with proposal'			
		8-9am		5-6pm		8-9am		5-6pm	
		Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS
Newcastle Inner City Bypass and Maitland Road	Signalised	24	C	62	E	23	C	33	C
Sparke Street and Maitland Road	Seagull Signalised	9	A	21	C	7	A	7	A
Shamrock Street and Maitland Road	Signalised	22	C	22	C	11	B	11	B
Old Maitland Road (south) and Maitland Road	Signalised	11	B	11	B	5	A	8	A
Old Maitland Road (north) and Maitland Road	Signalised	45	D	34	C	5	A	9	A
A1 Pacific Highway and Maitland Road	Signalised	60	E	40	D	18	B	22	C

Table 5.12 Performance of modelled intersections in 2038

Intersection	Type	2038 'do minimum'				2038 'with proposal'			
		8-9am		5-6pm		8-9am		5-6pm	
		Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS
Newcastle Inner City Bypass and Maitland Road	Signalised	54	D	72	E	41	D	27	C
Sparke Street and Maitland Road	Seagull Signalised	26	C	20	C	46	D	7	A
Shamrock Street and Maitland Road	Signalised	27	C	22	C	38	D	11	B
Old Maitland Road (south) and Maitland Road	Signalised	10	A	17	B	16	B	8	A
Old Maitland Road (north) and Maitland Road	Signalised	44	D	46	D	5	A	9	B
A1 Pacific Highway and Maitland Road	Signalised	63	E	79	E	23	C	22	C

Table 5.13 Performance of modelled intersections in 2048

Intersection	Type	2048 'do minimum'				2048 'with proposal'			
		8-9am		5-6pm		8-9am		5-6pm	
		Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS	Avg delay (sec)	LoS
Newcastle Inner City Bypass and Maitland Road	Signalised	72	E	58	E	40	D	32	C
Sparke Street and Maitland Road	Seagull Signalised	29	C	22	C	42	D	20	B
Shamrock Street and Maitland Road	Signalised	28	C	19	B	39	D	20	B
Old Maitland Road (south) and Maitland Road	Signalised	10	A	14	B	17	B	16	B
Old Maitland Road (north) and Maitland Road	Signalised	44	D	48	D	10	A	15	B
A1 Pacific Highway and Maitland Road	Signalised	72	E	78	E	30	C	33	C

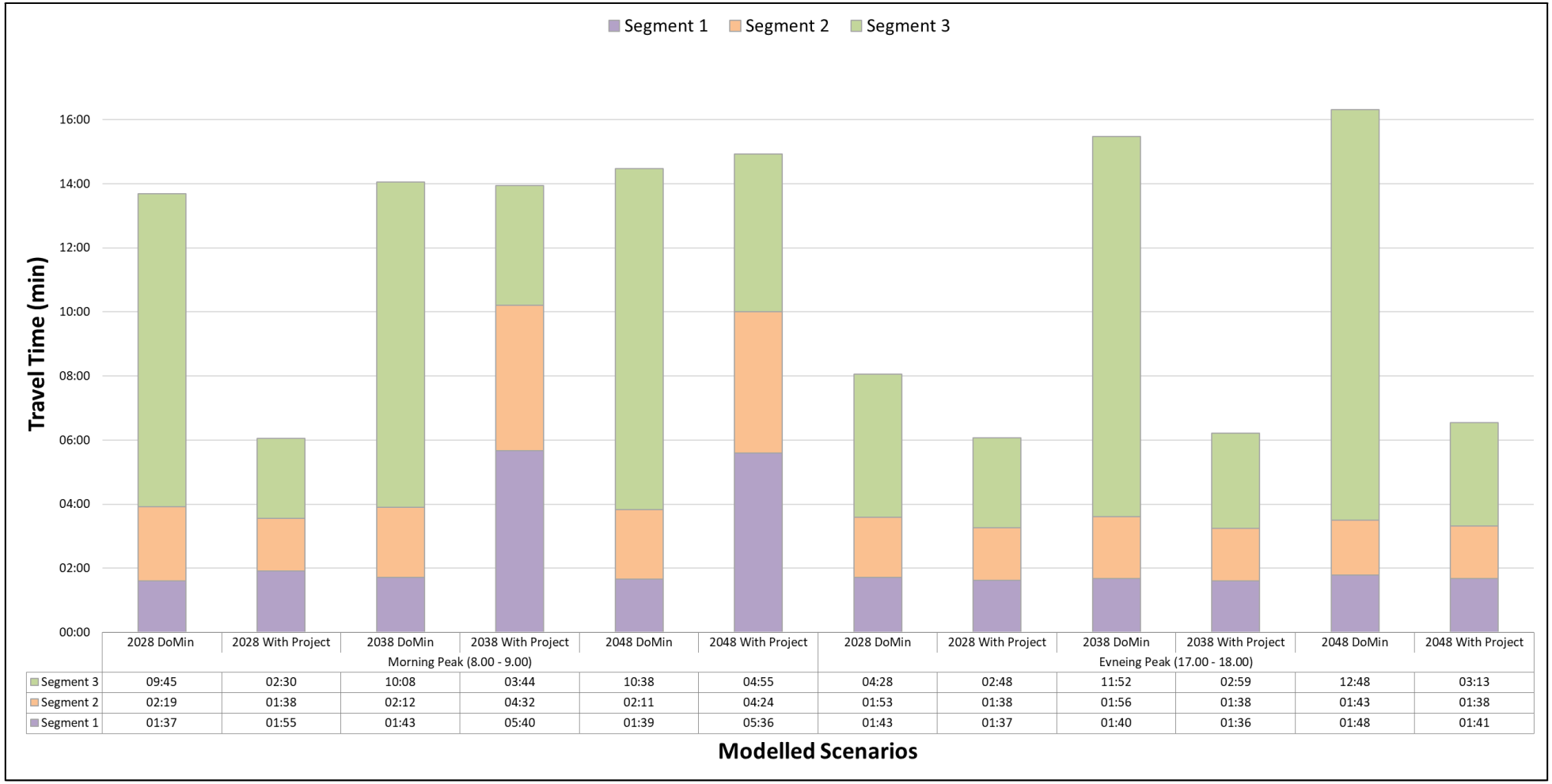
Analysis of the modelled intersections shows that the key differences in intersection performance are primarily at the following locations:

- A1 Pacific Highway and Maitland Road intersection located at the northern end of the proposal to the south of the Hunter River and Hexham Bridge: The proposal would substantially improve the performance of this intersection in both peak periods across all modelled years. The lane configuration from the east approach includes three left turn and two right turn lanes that operate under traffic signals. This new lane configuration is enabled by the construction of the M1 Motorway Extension to Raymond Terrace, which reduces the number of east to north traffic moments at this intersection as vehicles divert to the new motorway. Overall, the new lane configuration is designed to meet traffic demands for each approach to the intersection. This reduces the signal green time allocated to the east approach leading to increased signal green time for north-south movements on Maitland Road, resulting in greater north-south capacity and reduced delays at the intersection
- Old Maitland Road (north) and Maitland Road intersection: The proposal includes an additional northbound and southbound lane on Maitland Road. This increases the capacity of the intersection leading to a significant reduction in delays at this intersection
- Newcastle Inner City Bypass and Maitland Road intersection: The proposal provides an additional lane in the northbound and eastbound direction, adding capacity to the intersection which results in a reduction in delays and improved LoS. The provision of an additional left turn lane from the Newcastle Inner City Bypass leads to significant improvements in the delays and LoS for the eastbound approach
- Shamrock Street and Maitland Road intersection and Sparke Street and Maitland Road intersection: In 2038 and 2048 the delays at these intersections increase as a result of the proposal. This increase in delays can be attributed to an increase in traffic volume that occurs due to the release of additional trips and the change in traffic flow patterns. Furthermore, the shockwave that is formed in the southbound direction in the AM peak due to increased volumes, which is responsible for the increase in delays at these intersections. This originates from south of the Newcastle Inner City Bypass and Maitland Road intersection, where the Wallsend and Maitland Road intersection acts as a pinch point on the network.
- Traffic counts were undertaken in March 2021 at the Shamrock Street and Maitland Road intersection. Extrapolating growth from 2017 to 2021, it was found the model overestimates trips using Shamrock Street by approximately 20 per cent, thus the model results for Shamrock Street can be viewed as conservative. The real-world performance of the intersection is expected to be better in future years than the traffic model predicts.

Overall, all modelled intersections in 2028, 2038 and 2048 operate at a satisfactory LoS (LoS D or better) when modelled with the proposal. The proposal improves the capacity between the A1 Pacific Highway and Maitland Road intersection and the Newcastle Inner City Bypass and Maitland Road intersection which currently act as a pinch point. These improvements increase the traffic volume on Maitland Road leading to a slight increase in delays at the Shamrock Street and Maitland Road intersection and the Sparke Street and Maitland Road intersection for through traffic. The approaches of minor roads such as Sparke Street, Shamrock Street and Old Maitland Road to Maitland Road do not experience lengthy delays and have suitable capacity at the traffic signals to cater for demand. Overall, despite some increases in intersection delays, travel times over the entire length of the corridor decrease.

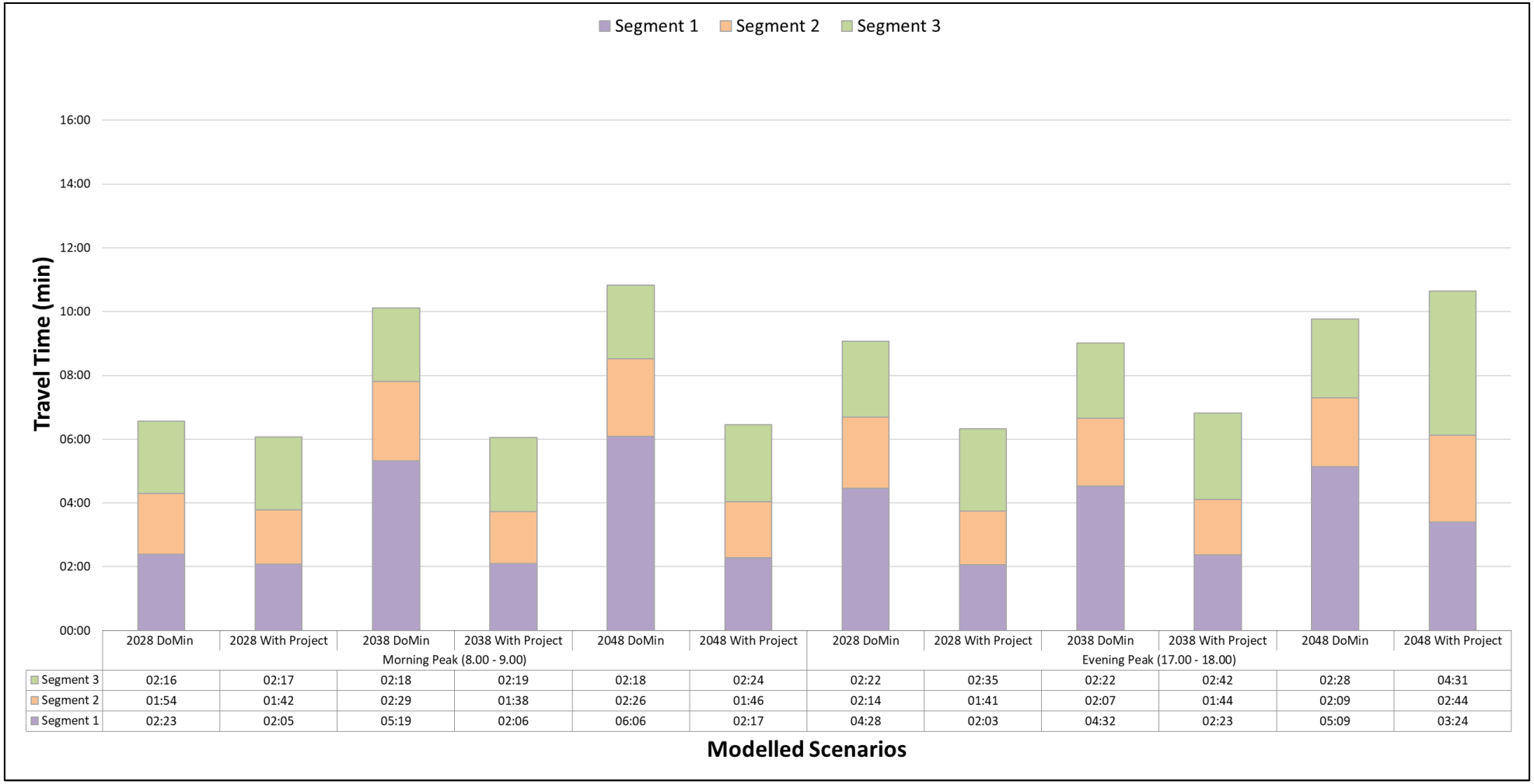
Travel time performance

A comparison between the travel times from 'do minimum' and 'with proposal' scenarios is presented in **Figure 5.8** and **Figure 5.9**. These figures display the travel times in the most congested hour during the morning and evening peak, which are 8-9am for the morning peak and 5-6pm for the evening peak. The figure displays the travel time for each segment of Maitland Road. **Figure 4.4** displays the segments where travel times were measured.



	Morning Peak (8.00 - 9.00)						Evneing Peak (17.00 - 18.00)					
	2028 DoMin	2028 With Project	2038 DoMin	2038 With Project	2048 DoMin	2048 With Project	2028 DoMin	2028 With Project	2038 DoMin	2038 With Project	2048 DoMin	2048 With Project
Segment 3	09:45	02:30	10:08	03:44	10:38	04:55	04:28	02:48	11:52	02:59	12:48	03:13
Segment 2	02:19	01:38	02:12	04:32	02:11	04:24	01:53	01:38	01:56	01:38	01:43	01:38
Segment 1	01:37	01:55	01:43	05:40	01:39	05:36	01:43	01:37	01:40	01:36	01:48	01:41

Figure 5.8 Southbound travel times on Maitland Road



	2028 DoMin	2028 With Project	2038 DoMin	2038 With Project	2048 DoMin	2048 With Project	2028 DoMin	2028 With Project	2038 DoMin	2038 With Project	2048 DoMin	2048 With Project
	Morning Peak (8.00 - 9.00)						Evening Peak (17.00 - 18.00)					
Segment 3	02:16	02:17	02:18	02:19	02:18	02:24	02:22	02:35	02:22	02:42	02:28	04:31
Segment 2	01:54	01:42	02:29	01:38	02:26	01:46	02:14	01:41	02:07	01:44	02:09	02:44
Segment 1	02:23	02:05	05:19	02:06	06:06	02:17	04:28	02:03	04:32	02:23	05:09	03:24

Figure 5.9 Northbound travel times on Maitland Road

Overall, the proposal results in faster travel times along the Hexham Straight corridor in both the northbound and southbound directions in all modelled scenarios. The main outcomes to travel time include:

- In the southbound direction, the most significant reduction in travel times occurs between the northern extent of the upgrades and Old Maitland Road (north) (segment 3). In this road segment, travel time is reduced by about 60 per cent. This occurs due to the reduction in delays at the A1 Pacific Highway and Maitland Road intersection
- In the direction of peak traffic flow (southbound in the morning peak and northbound in the evening peak), travel times in the segments along Maitland Road between Old Maitland Road (north) and the southern extent of the proposed road upgrades increase. This is a result of increased volumes on Maitland Road that occur due to the removal of network pinch points at the northern and southern ends of the study area
- In the northbound direction in 2048, there is a slight increase in travel times along the corridor. This occurs as the 'DoMin' model contains trips which are not released onto the Hexham Straight Corridor as they queue on the Newcastle Inner City Bypass. The provision of the third left turn lane on the Newcastle Inner City Bypass results in a greater number of vehicles being released onto Hexham Straight which impacts corridor travel times. This is shown in **Figure 5.10** which displays a comparison of the queues on the Newcastle Inner City Bypass in the Do Minimum and Proposal model.

In comparison to the 'do minimum' option, the proposal would reduce travel times on Maitland Road in the study area by about 34 per cent in 2028, about 31 per cent in 2038 and by about 27 per cent in 2048.

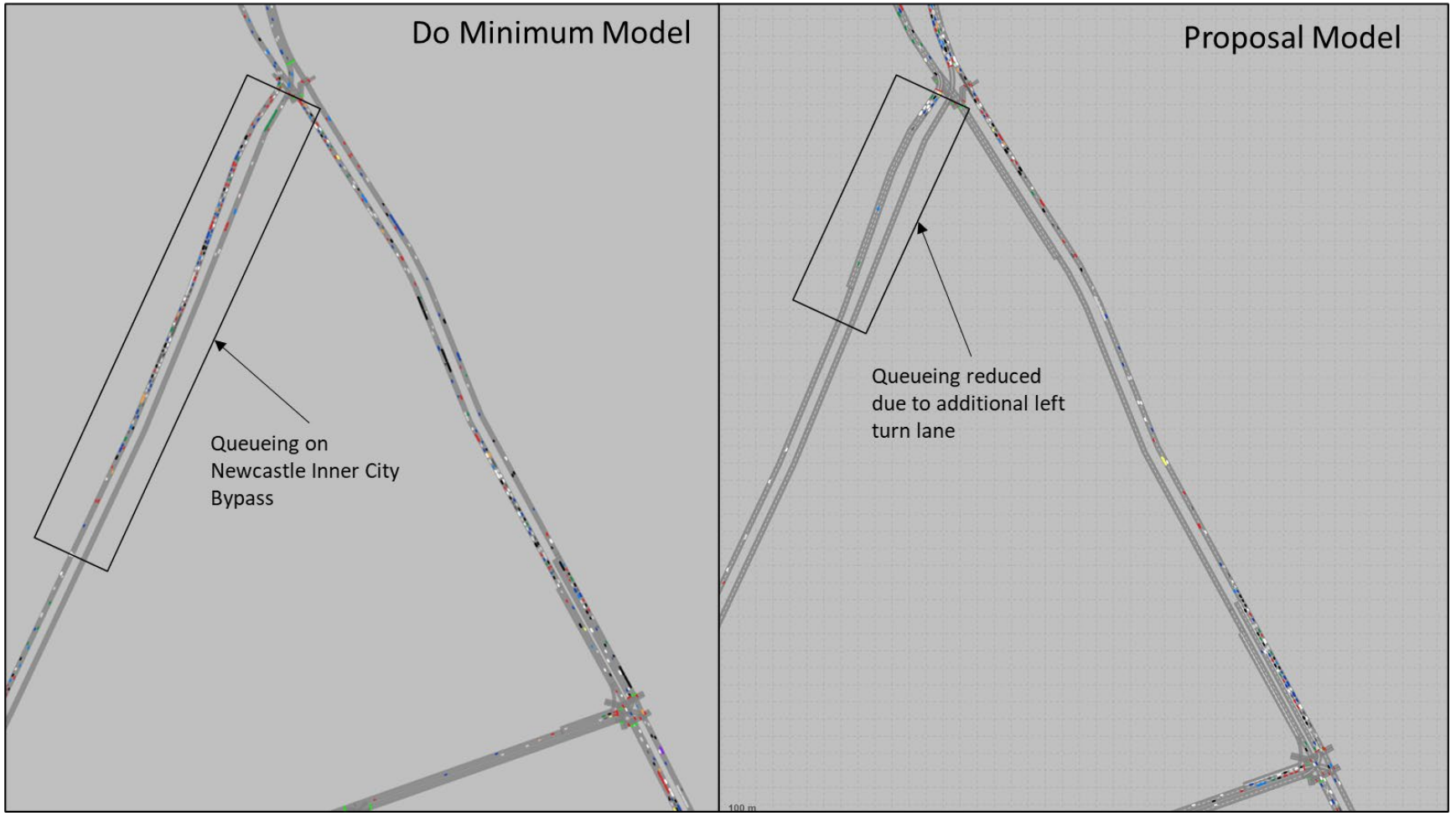


Figure 5.10 Comparison between the Do Minimum model and proposal model in the AM peak in 2048 at the Newcastle Inner City Bypass

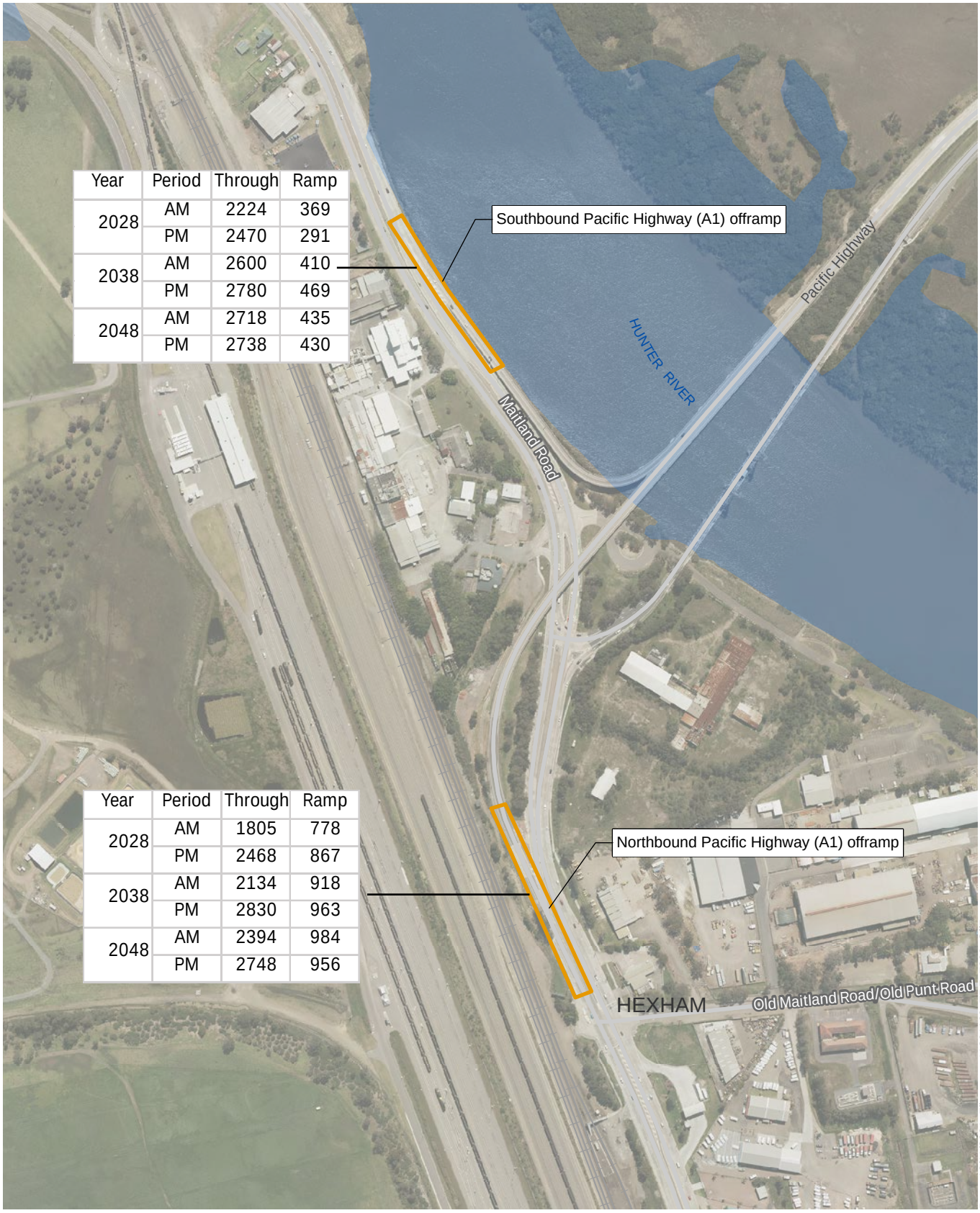
Interchange analysis

An analysis was carried out at the two offramps from Maitland Road to the A1 Pacific Highway and access to the bridges that cross the Hunter River at Hexham. Due to the nearby A1 Pacific Highway and Maitland Road signalised intersection, a density and speed interchange assessment was not suitable, therefore the diverge performance was assessed through a review of traffic volumes, queues and visually in the VISSIM model.

Figure 5.11 displays the traffic volumes using the off ramps during each of the peak periods in the modelled scenarios. Volumes for the southbound A1 Pacific Highway offramp are low as the M1 Pacific Motorway extension to Raymond Terrace provides an alternative east-west route, which results in less traffic travelling over Hexham Bridge. The single lane offramp from the north has a capacity of about 1,800 passenger car units (pcu) per hour (Austroads, 2017) and the dual lane offramp from the south has a capacity of about 3,600 pcu per hour (Austroads, 2017). The volume of traffic using each offramp is under the capacity for the road's configuration.

The southbound A1 Pacific Highway offramp begins approximately 700 metres north of the A1 Pacific Highway and Maitland Road intersection. The average queue at the northern approach to the A1 Pacific Highway and Maitland Road intersection is the longest in the 2048 morning peak with an average distance of 155 metres. The northbound A1 Pacific Highway offramp begins approximately 600 metres south of the A1 Pacific Highway and Maitland Road intersection. The 2048 evening peak had the longest northbound queues to the intersection with an average distance of 84 metres. Therefore, queues are unlikely to prevent vehicles from accessing either the northbound or southbound A1 Pacific Highway on and offramps.

The VISSIM model was also closely observed during peak periods and vehicle access to the offramps was not identified as an issue during any of the modelled scenarios.



Legend

- Offramp
- Railway
- Road
- Waterway

0 100 200 m

Scale 1:5,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.11 Traffic volumes on the A1 Pacific Highway off ramps at Hexham

5.3.2 Impact on public transport

Bus services

Widening of the existing lanes for the proposal would not affect current bus routes. The proposal would improve bus travel time reliability due to decreased congestion and improved intersection performance within the study area. Some bus stops would be relocated to provide safer connectivity and access, these changes are:

- A new bus stop will be provided on the eastern side of Maitland Road for northbound buses about 50 metres north of the Newcastle Inner City Bypass and Maitland Road intersection
- The bus stop located on the southbound carriage way of Maitland Road opposite Calvary St Joseph's Retirement Community would be relocated about 70 metres south to provide better connectivity to the pedestrian operated signals and the Calvary St Joseph's Retirement Community
- The bus stop located on Maitland Road opposite Shamrock Street would be relocated about 50 metres south to provide better connectivity to the signalised pedestrian crossing at the Shamrock Street and Maitland Road intersection
- The bus stop located on Maitland Road opposite Fenwick Street would be removed
- The two bus stops located on Maitland Road at the Hexham Bowling Club would both be relocated south to provide better connectivity to the signalised pedestrian crossing at the Old Maitland Road (south) and Maitland Road intersection and the Hexham Bowling Club
- The bus stops located on Maitland Road opposite property 338 would be removed
- The bus stop located on Maitland Road opposite Old Maitland Road (north) would be relocated south of the Old Maitland Road (north) and Maitland Road intersection to provide better connectivity to Hexham Railway Station.

A map of these bus stop location changes can be seen in **Figure 5.12**.

Interaction with rail infrastructure

There would be no impact to the function of the Main North Rail Line and Hexham train support facility during the proposal's operation. Access to Hexham Railway Station and ARTC assets via Maitland Road would be formalised as part of the Maitland Road and Old Maitland Road (north) intersection at Hexham and the design includes a new station access road connecting this intersection and the Hexham Railway Station.

Vehicle access to Hexham Railway Station from the south would be provided by a new left-turn slip land about 100 metres south of the train station. Vehicles accessing Hexham Railway Station from the north would be required to turn left from Maitland Road into Old Maitland Road (north) and perform a U-turn at Old Punt Road before travelling straight through the Old Maitland Road (north), the rail maintenance access road and Maitland Road intersection via a single lane to the train station carpark.

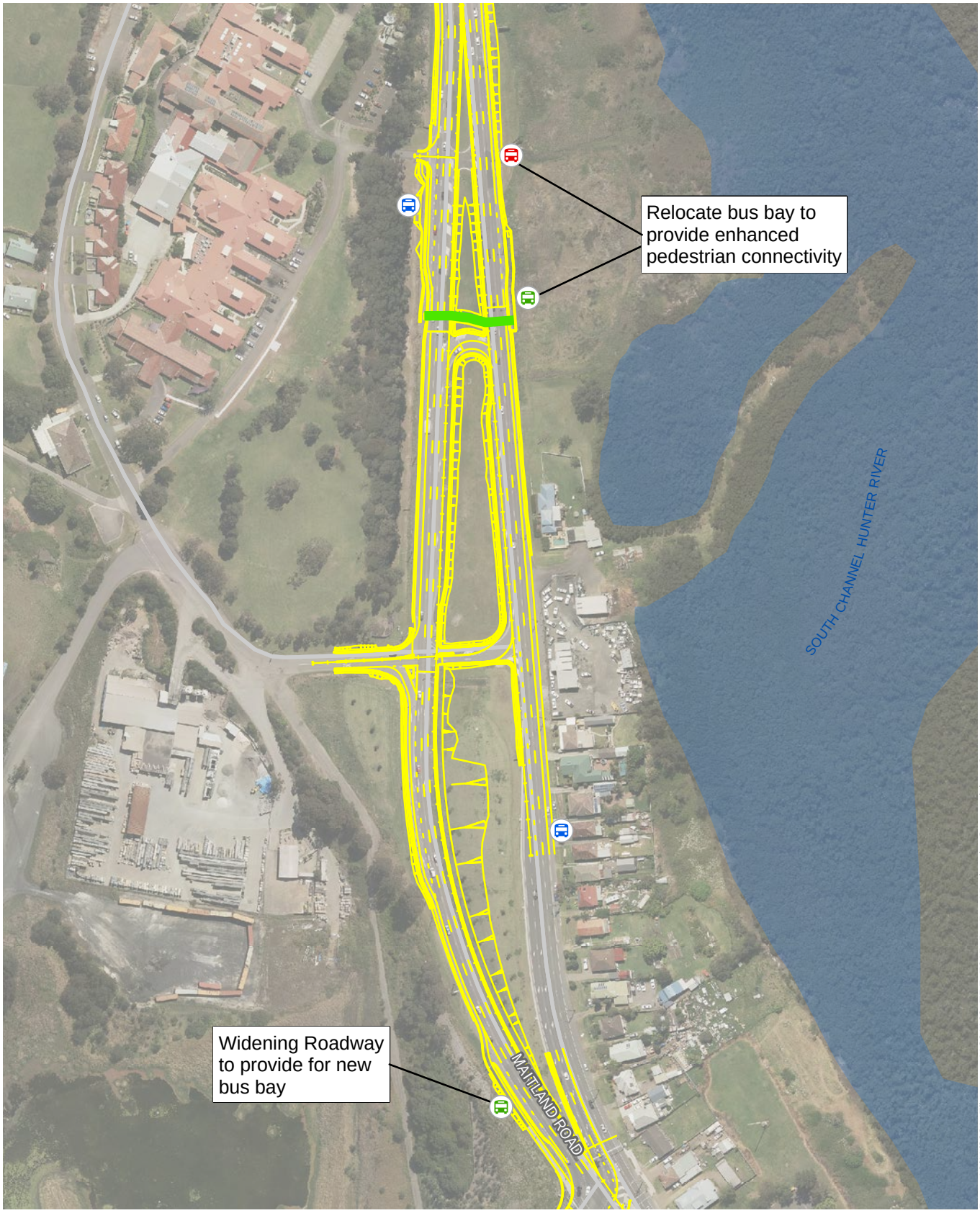
5.3.3 Impact on the pedestrian network

The proposal includes upgraded pedestrian crossing facilities at some of the signalised intersections along Maitland Road and including:

- Across the eastbound and westbound lanes of the Newcastle Inner City Bypass and across the northbound travel lanes of Maitland Road
- Across the north bound and southbound Maitland Road travel lanes to the north of the U-turn crossing near Calvary St Joseph's Retirement Community entrance
- Across the northbound access road into Sparke Street

- At Shamrock Street intersection across the northbound and southbound Maitland Road travel lanes and across the eastbound and westbound Shamrock Street travel lanes
- At Old Maitland Road (south) intersection across the northbound and southbound Maitland Road travel lanes
- At the A1 Pacific Highway intersection across the northbound and southbound Maitland Road travel lanes and across the A1 Pacific Highway travel lanes into Newcastle
- At the Oak Factory access road, two signalised pedestrian crossings are proposed and includes one across the northbound access road into the Oak Factory and one across the eastbound and westbound travel lanes of the Oak Factory access road and the Maitland Road intersection.

These changes to the pedestrian network would improve connectivity, improve desire lines and provide safer access to bus stops, Hexham Railway Station and adjacent commercial and industrial properties. These improvements are displayed in **Figure 5.12.**



Legend

- Concept design
- Pedestrian connectivity

Bus stops

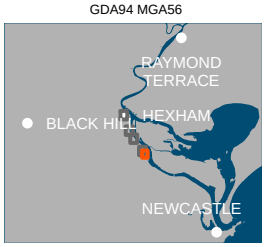
- New bus stop
- Retain bus stop
- Remove bus stop

- Railway
- Road
- Waterway

0 50 100 m

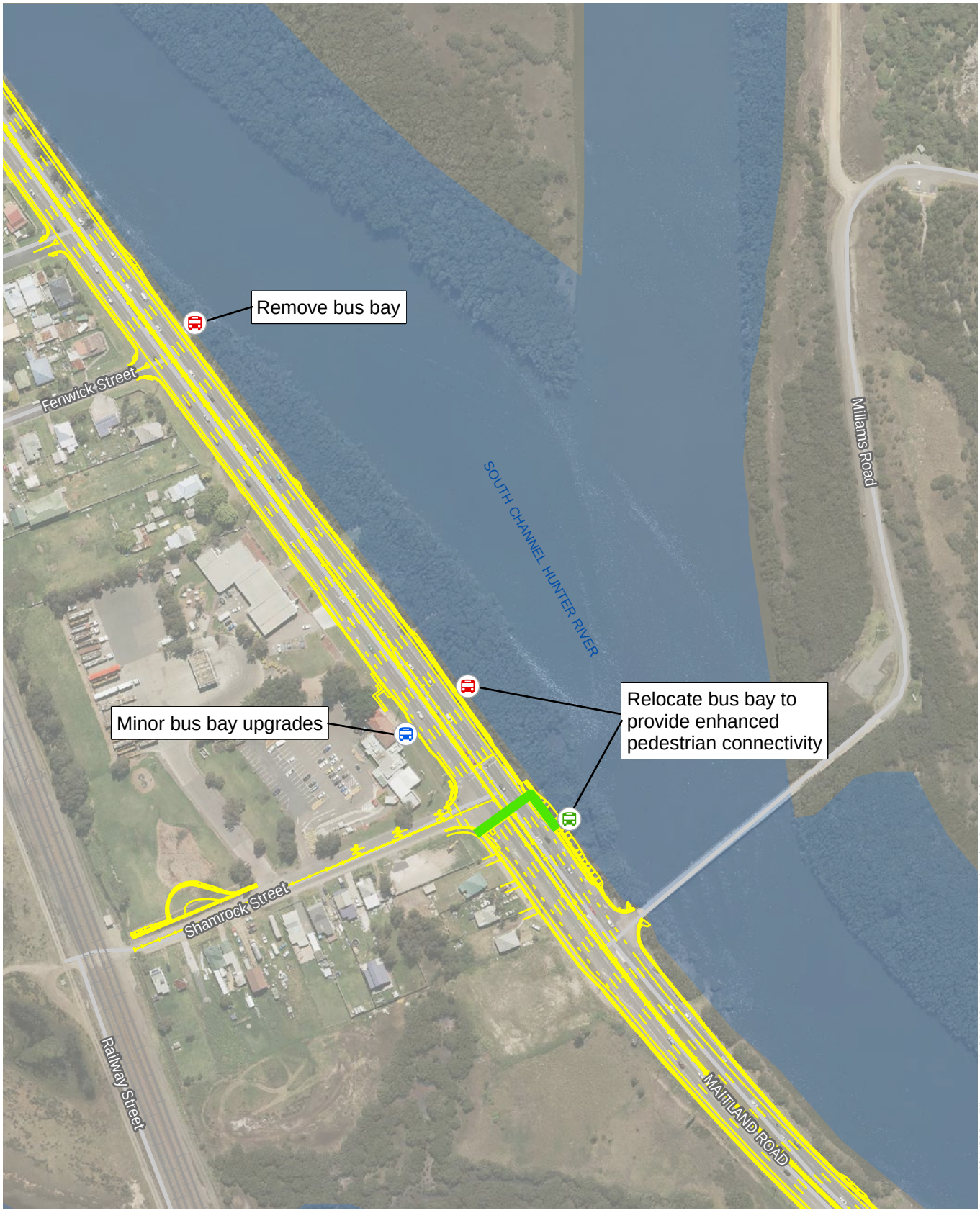
Scale 1:3,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.12a Changes to bus bay locations and pedestrian connectivity from the proposal Hexham Straight Widening



Legend

- Concept design
- Pedestrian connectivity

Bus stops

- New bus stop
- Retain bus stop
- Remove bus stop

- Railway
- Road
- Waterway

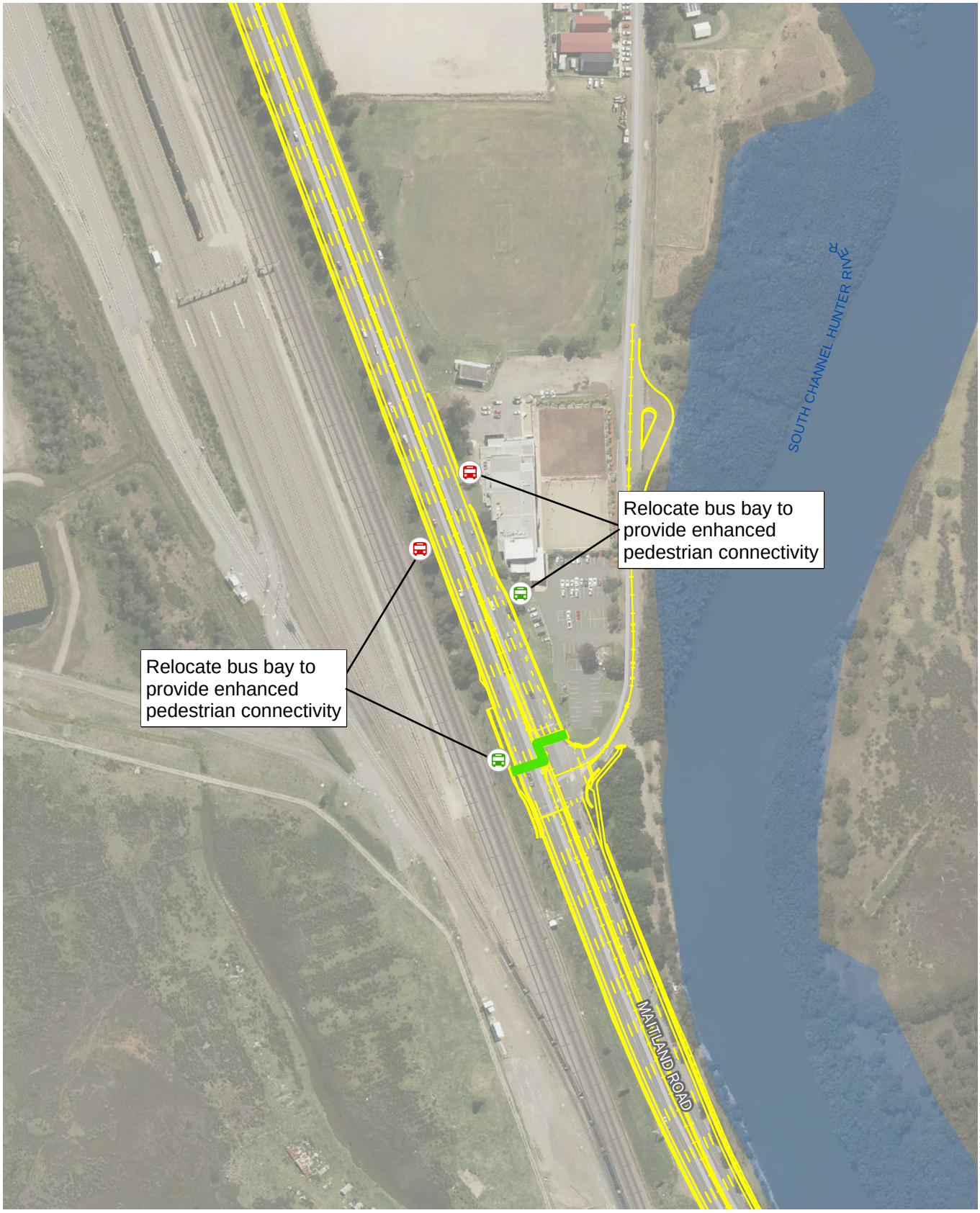
0 50 100 m

Scale 1:3,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.12b Changes to bus bay locations and pedestrian connectivity from the proposal Hexham Straight Widening



Legend

- Concept design
- Pedestrian connectivity

Bus stops

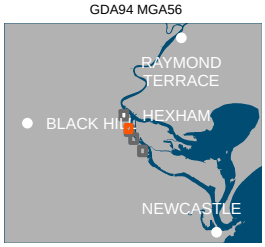
- New bus stop
- Retain bus stop
- Remove bus stop

- Railway
- Road
- Waterway

0 50 100 m

Scale 1:3,000 at A4

GDA94 MGA56



Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.12c Changes to bus bay locations and pedestrian connectivity from the proposal Hexham Straight Widening

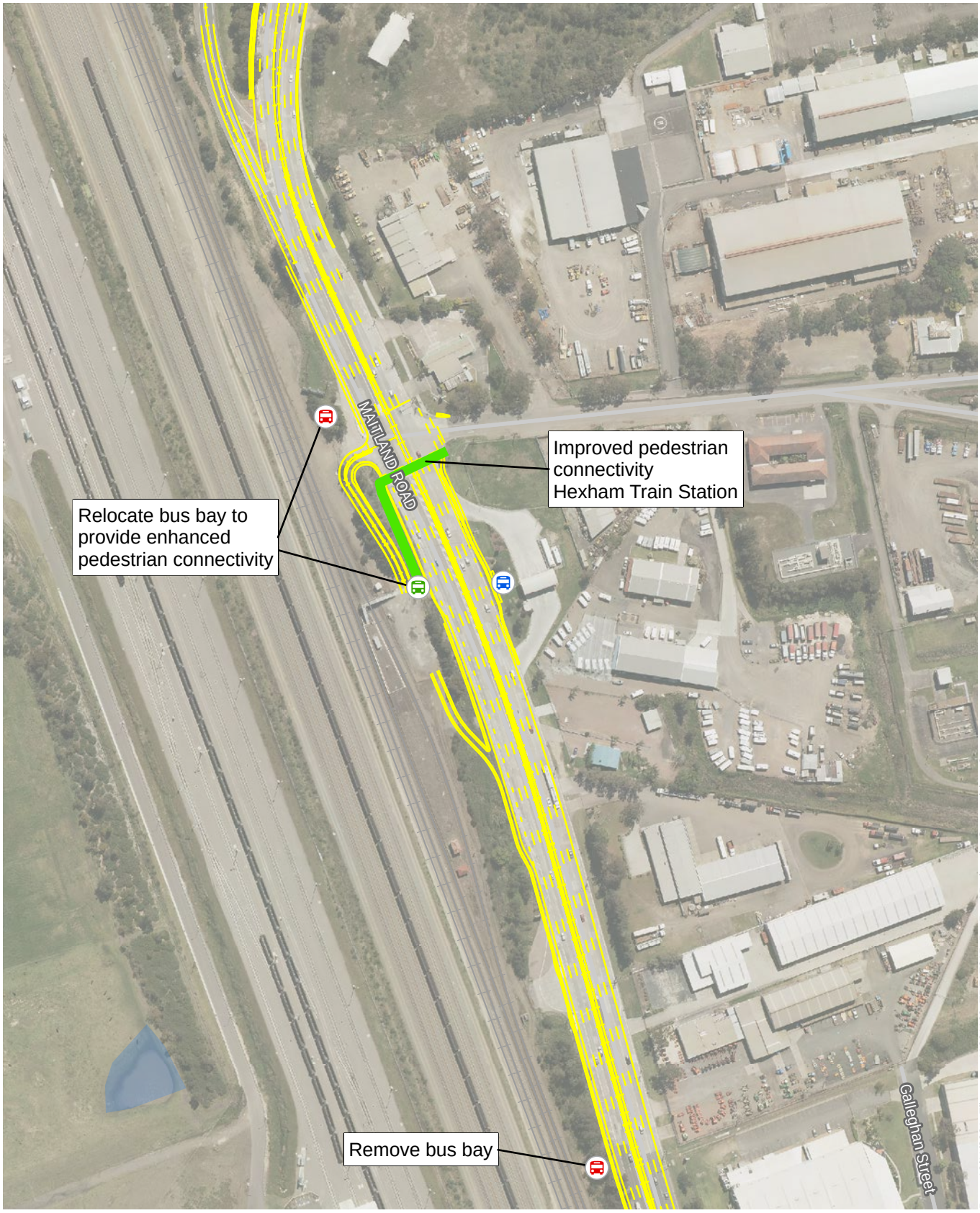


Figure 5.12d Changes to bus bay locations and pedestrian connectivity from the proposal Hexham Straight Widening

5.3.4 Impact on the cycle network

The proposal includes a dedicated two metre-wide shoulders for cyclist which would improve cycle connectivity through the study area and encourage an increased mode share to cycle.

The proposal also includes changes to the cycling network in the following locations:

- The short cycle lane at the east approach to the A1 Pacific Highway and Maitland Road intersection would be removed. This would be replaced with off-road provisions at the intersection which would connect to the off-road shared path located on the eastern side of Maitland Road between the A1 Pacific Highway and Maitland Road intersection and the Old Maitland Road (north), the rail access maintenance road and Maitland Road intersection
- The dedicated-on road cycle lane at the northern approach to the A1 Pacific Highway intersection and Maitland Road would be removed. A shoulder would be provided at the intersection for southbound cyclists to use
- A new 900 metre shared user path along Maitland Road on the western side of Maitland Road north of the Oak Factory access road and the Maitland Road intersection (refer to **Figure 5.13**)
- A new 330 metre shared user path along the western side of Newcastle Inner City Bypass on the approach to Maitland Road.

5.3.5 Impact on freight

The future land releases in the model area are expected to substantially increase the generation of new freight movements in future years. This would be driven predominately by the Black Hill development and developments around Tomago and Heatherbrae. 'Do Minimum' modelling results indicate that substantial congestion on Hexham Straight, lengthy delays and increased travel times apply for all vehicles including freight. The proposal would substantially improve the operation of road freight within the modelled area by substantially reducing delays and travel times.

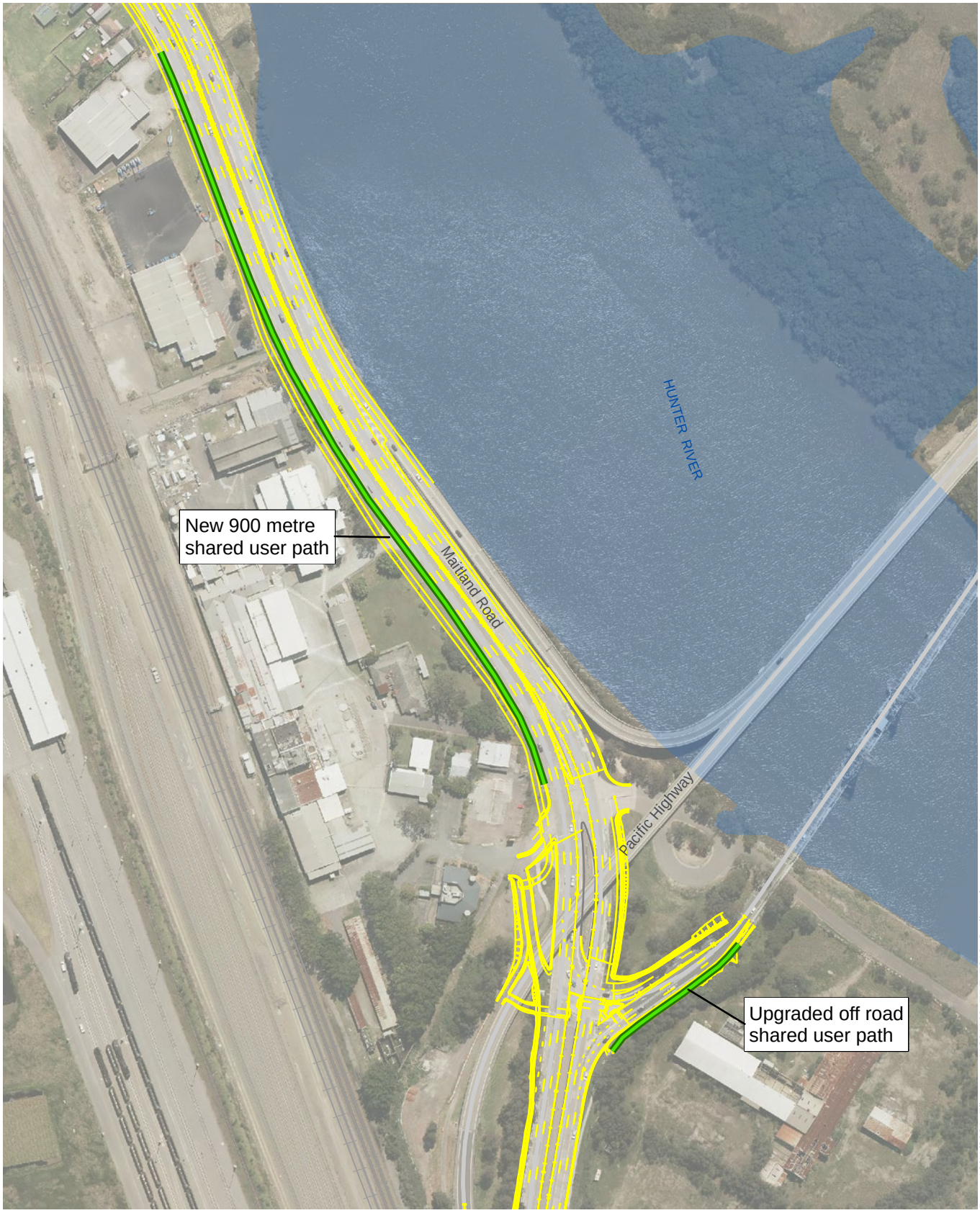
The travel time benefits outlined in **Section 5.3.1** are also valid for freight vehicles that would benefit from travel time improvements on Hexham Straight. Thus, the proposal would reduce travel times on Maitland Road in the study area for freight by about 30 per cent in future years. Furthermore, the proposal would also reduce the total number of stops made by vehicles in the network, which results in freer flowing traffic and greater efficiency of heavy vehicle operations.

5.3.6 Impact on road safety

The proposal includes a dual carriageway with a central median with solid barrier, which would improve safety for all road users (including cyclists and pedestrians). The proposal would generally improve road safety by:

- Improving traffic flow, reducing the number of stops vehicles make leading to a decreased risk of crashes
- Removal of the southbound merge to the south of the Old Maitland Road (south) and Maitland Road intersection would decrease lane change crashes
- Improvements to the cycle network at the northern end of the proposal through improved cycling infrastructure as described in **Section 5.3.2** would reduce the risk of cyclist crashes in this location.
- Removal of uncontrolled U-turn provisions.

The proposal would result in improved safety outcomes for all road users in the study area.



Date: 12/11/2021 Filename: IA301100_TRF_F010_CyclingInfrastructure_v3

Legend

- Concept design
- Proposed shared user path
- Road
- Waterway

0 100 m

Scale 1:3,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.13 New cycling infrastructure proposed at the northern end of the proposal

5.3.7 Impact on property access

The proposal would impact access to a few informal locations and private properties through the closure of the median at four locations and minor changes in access arrangements. The removal of the median has been adopted by the proposal as an unsignalised turn across three lanes is a safety risk, as there is increased driver exposure to high volumes of opposing traffic on multiple lanes and at increased speeds. Transport has commenced consultation with impacted property owners and would continue to consult with affected landowners regarding access during detailed design. Locations with impacted accesses on completion of construction are summarised below:

- Closure of the median along Maitland Road at Millams Road would impact access to and from Ash Island Bridge and Hunter Wetlands National Park. Millams Road access would be left-in and left out only. Vehicles accessing Millams Road from the south would be required to travel an additional 470 metres to use the U-turn facility in Shamrock Street to access Millams Road from the north. Vehicles departing Millams Road to the north would be required to travel an additional 1.7 kilometres to the south to use the U-turn facility at Sparke Street (refer to **Figure 5.14**)
- The informal service road located on the western side of Maitland Road at the approach to Shamrock Street would be removed. Access to three properties (15 to19) on Maitland Road would be maintained via new driveways constructed off Maitland Road via the shoulder (refer to **Figure 5.15**)
- The median on Maitland Road at Fenwick Street would be closed and the right turn into and out of Fenwick Street would be removed. Access to Fenwick Street would be left in and left out only. Vehicles accessing Fenwick Street from the north, would be required to travel an additional 840 metres and turn right at the Shamrock Street and Maitland Road intersection in order to use the new U-turn facility that would be provided on the western end of Shamrock Street. Vehicles departing Fenwick Street to travel south would be required to travel an additional 1.4 kilometres turning right at the Old Maitland Road and Maitland Road intersection to the south of the Hexham Bowling Club and then using the new U-turn facility located about 220 metres to the north-east of the intersection. The closure of the median at Fenwick Street would impact all residential properties located to the west of Maitland Road and north of the service station (refer to **Figure 5.16**)
- The closure of the median on Maitland Road north of Shamrock Street and the subsequent rerouting of vehicles to the U-turn facility on Shamrock Street would result in additional vehicles on Shamrock Street. Analysis undertaken using the Guide to Traffic Generating Developments (Roads and Traffic Authority, 2002) found that the closure of the medians expected to lead to approximately 45 additional vehicles traveling on Shamrock Street daily. Traffic counts undertaken in March 2021 indicate approximately 2,150 vehicles currently use Shamrock Street daily, therefore the closure of the median is expected to lead to a two per cent increase in traffic movement which is not considered significant. Furthermore, as specified in **Section 5.3.1**, the Shamrock Street and Maitland Road intersection would continue to operate at a satisfactory level of service
- Closure of the median and the right-turn facility at Gilbert & Roach Trucks would mean drivers would have to make a detour when accessing the facility form the south. Two options are available and include:
  - Accessing the rear of the property from Galleghan Street via Old Maitland Road (south). This would be an increase of between 200 metres but would only be available for light vehicles
  - Using the existing U-turn facility at the northern end of the proposal opposite the Oak Factory access road (heavy and light vehicles permitted) which would be increase in 2.4 kilometres. Vehicles could access the front access on Maitland Road

  Vehicles heading north when leaving the property, would have to exit Gilbert & Roach Trucks via the rear access on Galleghan Street turning left onto Old Maitland Road to access the Old Maitland Road (north) and Maitland Road intersection (refer to **Figure 5.17**)
- Closure of the right-turn facility at Gilbert & Roach trucks would mean drivers of light vehicles accessing Industrial Galvanizers Corporation from the south are unable to perform U-turns on Maitland Road and

would be required to access the property from the entrance at Old Maitland Road, or alternatively use the detours proposed for Gilbert & Roach Trucks discussed above and shown in **Figure 5.17**

- Access to the Hexham Railway Station for northbound vehicles would be modified to include a new left slip lane about 150 metres to the south of the existing access road. For southbound vehicles travelling to the Hexham Railway Station the closure of the U-turn facility on Maitland Road opposite Truckline Newcastle would require vehicles to use Old Maitland Road (either north or south) at Hexham to access the station. A new access road has been added to the western side of the intersection of Old Maitland Road (north) and Maitland Road to Hexham Railway Station
- Closure of the median and the U-turn facility on Maitland Road opposite Truckline Newcastle at Hexham would mean drivers of light vehicles exiting the Ampol Hexham Diesel Stop and Truckline Newcastle to head north to Beresfield would be required to turn around at the intersection of Old Maitland Road (south) and Maitland Road, increasing travel distance by up to 2.7 kilometres. Heavy vehicles would need to continue south to use the U-turn facility at Sparke Street, increasing travel distance by up to six kilometres (refer to **Figure 5.18**)
- Access to the Oak Factory to the north of the A1 Pacific Highway and Maitland Road intersection would be upgraded to a short left-turn slip lane from Maitland Road to provide safer access. Access southbound to this site would be via the existing right turn lane at the signalised intersection. The uncontrolled right turn 150 metres to the north of this would be removed as a solid median barrier would be in place
- Closure of the median at Brancourts Dairy along with the right in and right out movements. Access to Brancourts Dairy northbound would be maintained as left in and left out only. Access for southbound traffic would be via the existing signalised intersection of the Oak Factory southern access road (refer to **Figure 5.19**). Vehicles exiting the site and travelling south would use the existing southern access signalised intersection to turn right onto Maitland Road.

No property has been identified as requiring a permanent property adjustment. All impacted driveway accesses would be reinstated following the completion of the proposal.

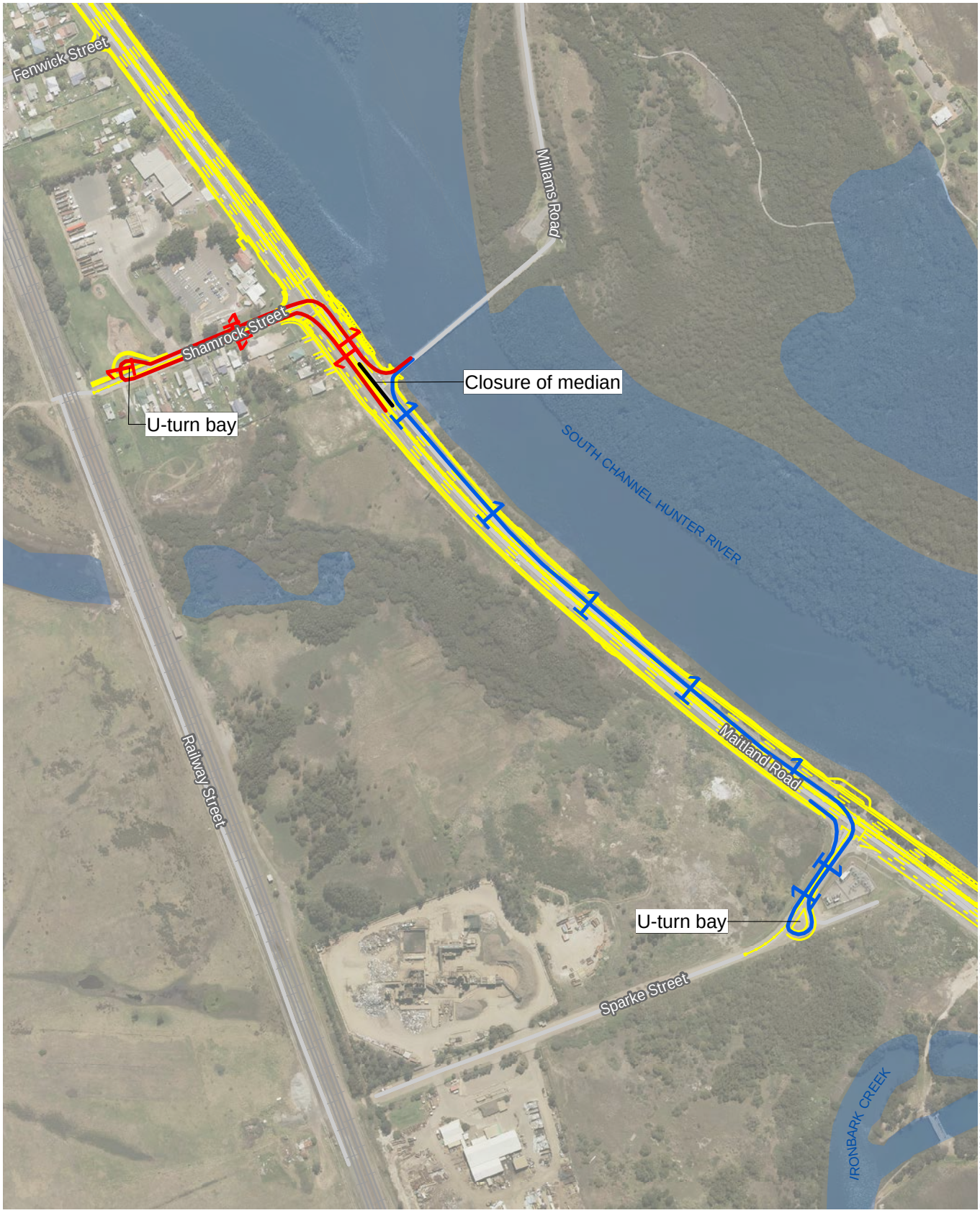
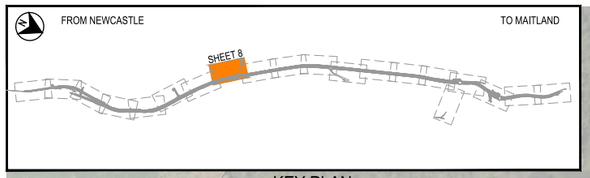


Figure 5.14 Proposed detour routes due to the closure of the median at Millams Road

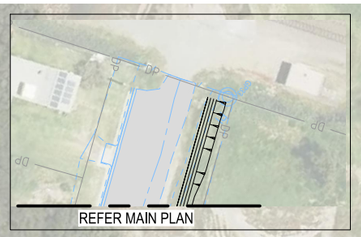
LEGEND

GENERAL

- EXISTING ROAD LAYOUT
- EXISTING BOUNDARY FENCE
- LOT 1 DP 573254 — CADASTRAL LOT AND DP NUMBER
- DP — EXISTING CADASTRAL BOUNDARY
- EXISTING PAVEMENT
- PROPOSED RETAINING WALL
- CYCLE ROUTE - PAINTED
- CYCLE ROUTE - UNPAINTED
- BUS BAY
- HUNTER WETLANDS NATIONAL PARK
- BUS SHELTER
- BRIDGE DECK



KEY PLAN
NTS



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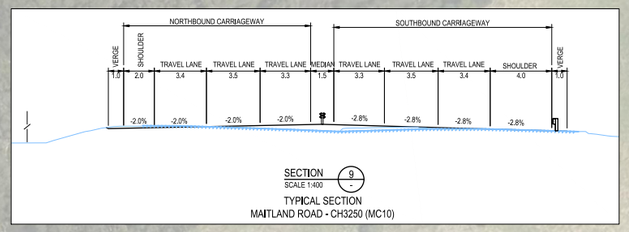
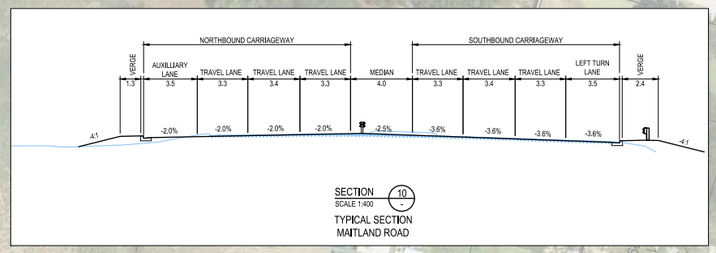


SECTION 9 SCALE 1:400
TYPICAL SECTION
MAITLAND ROAD - CH3250 (MC10)



SECTION 10 SCALE 1:400
TYPICAL SECTION
MAITLAND ROAD

FROM NEWCASTLE

TO MAITLAND

9

10

ON ROAD CYCLE ROUTE

MEDIAN CLOSURE NEW BACK TO BACK STEEL POST AND RAIL SAFETY BARRIER

PROPERTY ACCESS DRIVEWAYS

EXISTING SIGNALISED INTERSECTION

SHAMROCK STREET U-TURN FACILITY

SHAMROCK STREET

BUS STOP

MAITLAND ROAD A43

BACK TO BACK STEEL POST AND RAIL

ON ROAD CYCLE ROUTE

SOUTH CHANNEL HUNTER RIVER

MILLAMS ROAD

RELOCATED BUS STOP

EASEMENT FOR BATTER

EASEMENT FOR SLOPE

LOT 33 DP 803794

LOT 1 DP 88585

LOT 1 DP 659923

Figure 5.15 Property access modifications required as part of the proposal to the south of Shamrock Street

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY C:\users\scouley\appdata\local\projectwise\jacobs_anz_ie\d0349917\IA301100-HSW-RD-SKE-0101-0120.dwg - 29/07/2021 2:03:34 PM - SCouley				
DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
IA301100-HSW-RD-M3D-0005-Proposed Road Design Model-02.txt	A	04.06.2021	ENVIRONMENTAL ASSESSMENT PUBLIC EXHIBITION	F NAPOLITANO
	B	29.07.2021	ENVIRONMENTAL ASSESSMENT PUBLIC EXHIBITION	F NAPOLITANO

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:1000 (10 0 10 20) AT A3

CO-ORDINATE SYSTEM: MGA ZONE 56 — HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER: IA301100-HSW-RD-SKE-0108

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DESIGN	R TIRICOVSKI	29.07.2021
DESIGN CHECK	P DAYAL	29.07.2021
DESIGN MNGR	T DALEY	29.07.2021
PROJECT MNGR	F NAPOLITANO	29.07.2021

CLIENT: NSW GOVERNMENT Transport for NSW

PREPARED FOR: HUNTER REGION ENGINEERING SERVICES NEWCASTLE

NEWCASTLE COUNCIL LGA
MAITLAND ROAD A43
HEXHAM STRAIGHT WIDENING

EA PUBLIC EXHIBITION
PLAN

A3

SHEET 8 OF 20

RMS REGISTRATION No. DS2020/000432 — PART RD

ISSUE STATUS: FOR INFORMATION — EDMS No. — SHEET No. RD-0108 — REV B

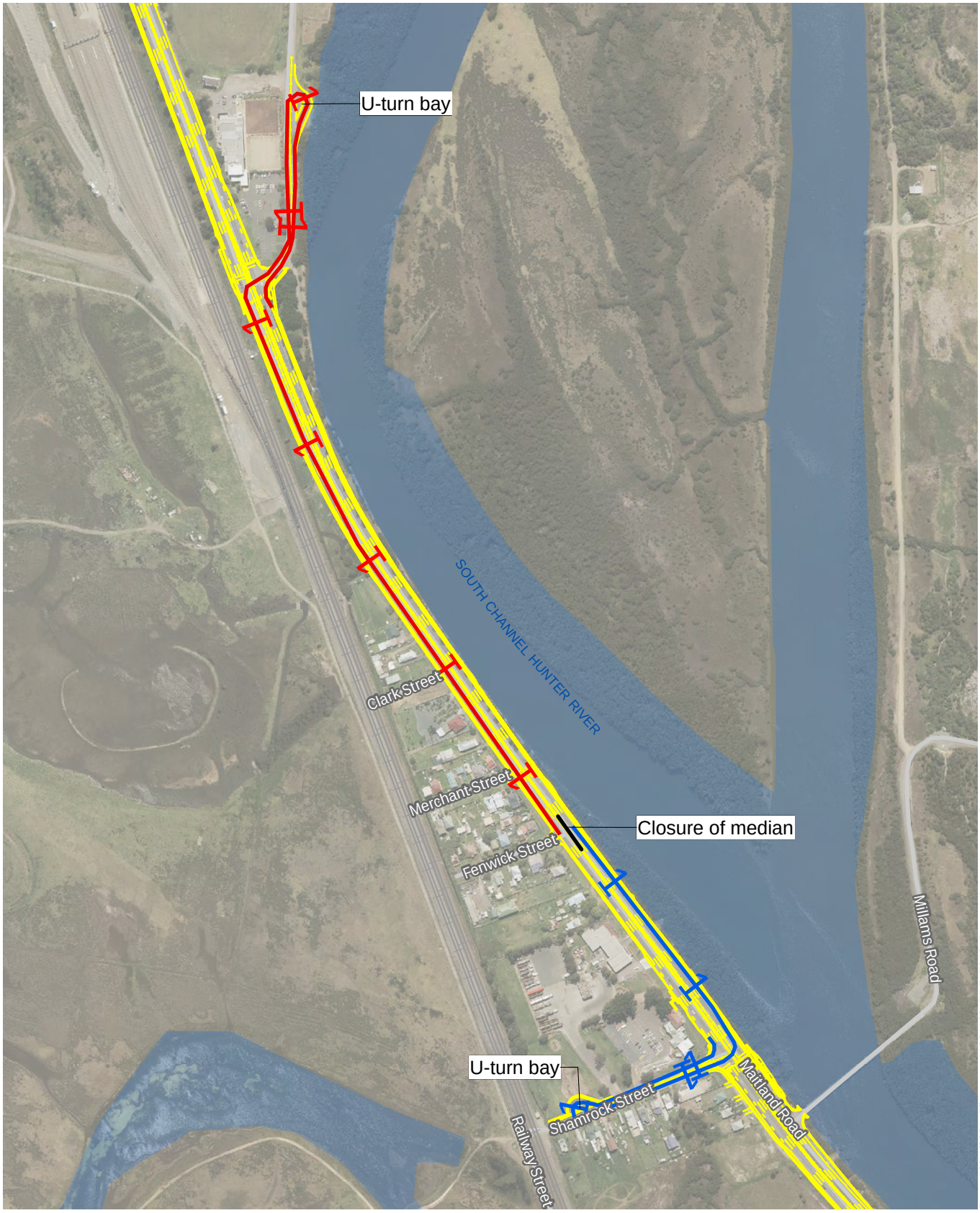
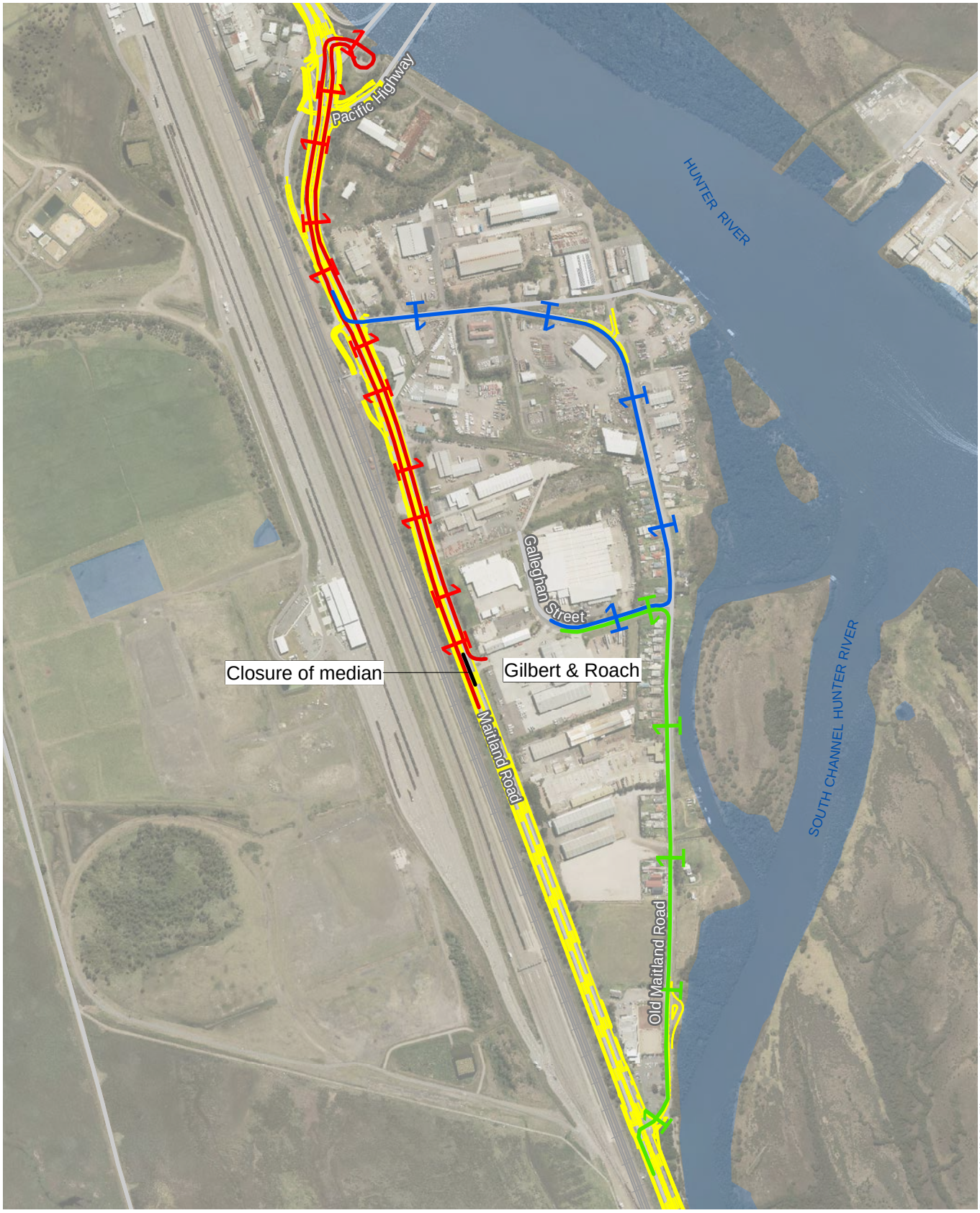


Figure 5.16 Proposed detour routes due to the closure of the median at Fenwick Street



Legend

- The proposal
- Departure detour route (heavy vehicle route)
- Departure detour route (light vehicles only)
- Access detour route
- Closure of median
- Railway
- Road
- Waterway

0 100 200 m

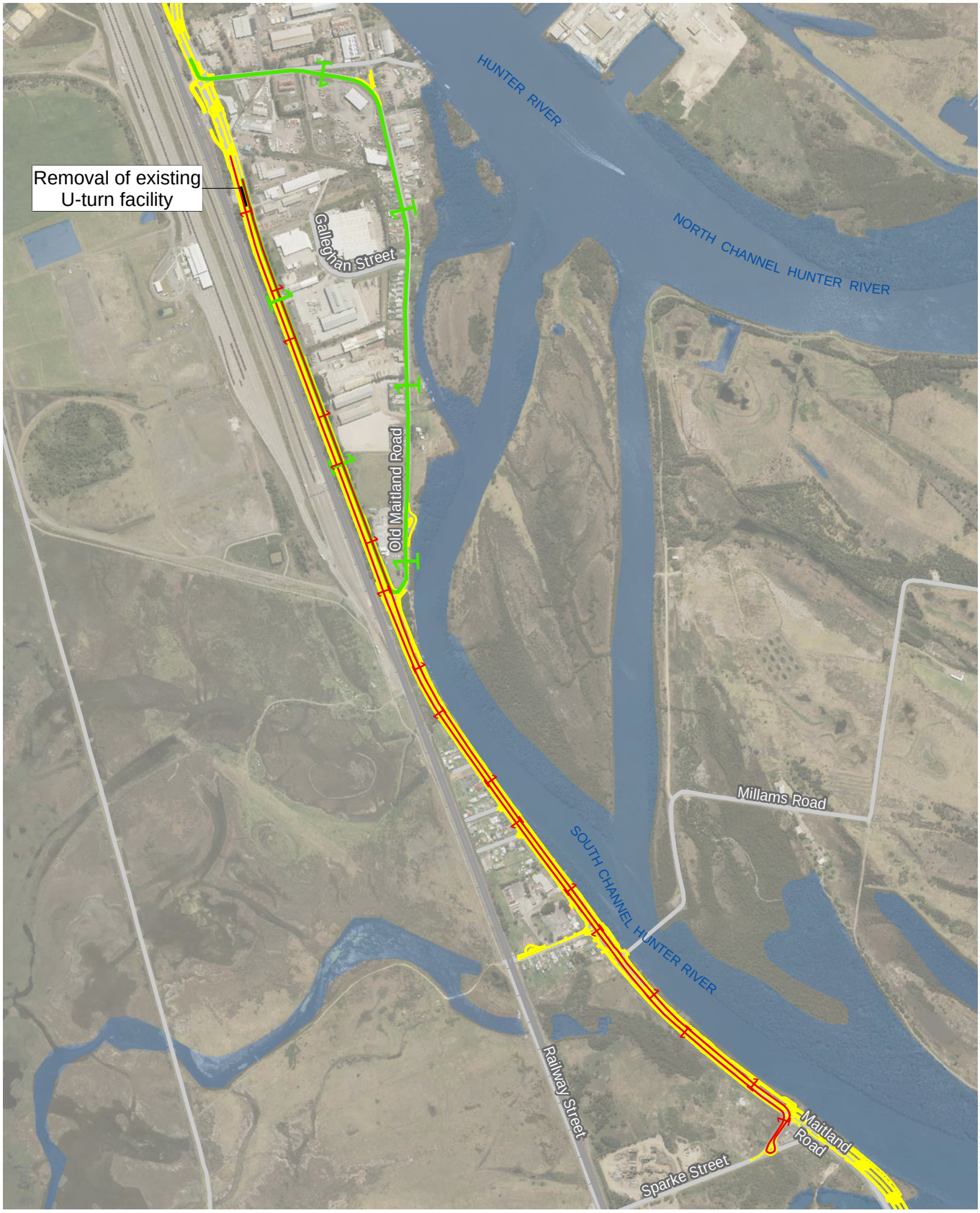
Scale 1:9,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Date: 12/11/2021 Filename: IA301100_TRF_F019_PropertyDetourRoutes_GilbertAndRoach_v4

Figure 5.17 Proposed detour routes due to the closure of the median at Gilbert & Roach



Legend

- The proposal
- Departure detour route (heavy vehicles)
- Departure detour route (light vehicles only)
- Removal of existing U-turn facility
- Road
- Railway
- Waterway

0 200 400 m

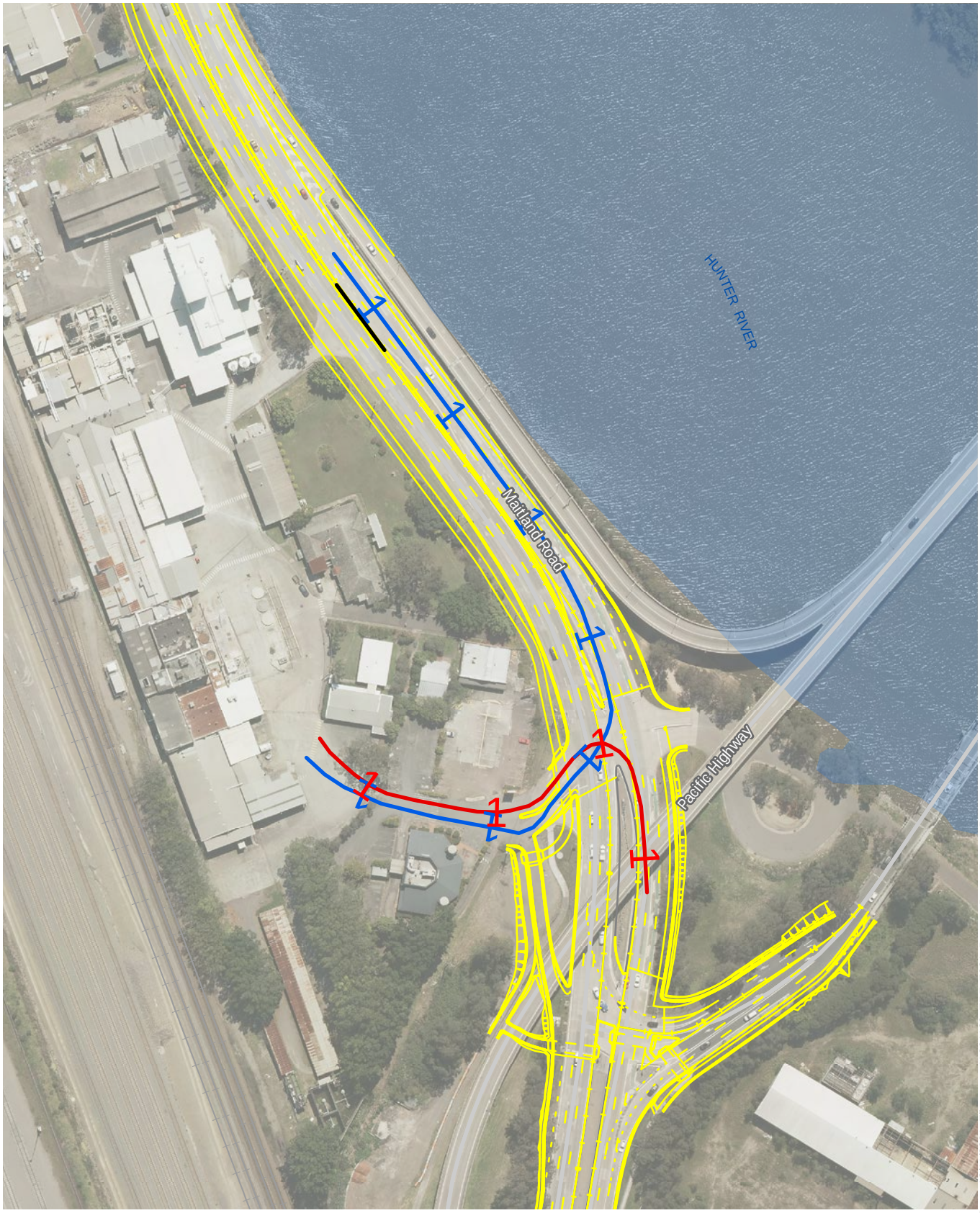
Scale 1:14,000 at A4

GDA94 MGA56

Data sources:

Jacobs 2020
Department Finance, Services and Innovation 2020

Figure 5.18 Proposed detour routes due to the closure of the U-turn facility opposite Truckline Newcastle



Legend

- The proposal
- Departure detour route
- Access detour route
- Closure of median
- Railway
- Road
- Waterway

0 40 80 m

Scale 1:2,000 at A4

GDA94 MGA56

Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

Date: 12/11/2021 Filename: IA301100_TRF_F021_PropertyDetourRoutes_Brancourt_v2

Figure 5.19 Proposed detour routes due to the closure of the median at Brancourt's Dairy

5.4 EIS area operation impacts

The EIS area only assesses impacts of the proposal within land subject to the CM SEPP and as shown in **Figure 1.3**. There will be no impact on the EIS area from changes in traffic and transport conditions during operation of the proposal except for the following:

- The loss of the existing access road in EIS Area 1 located on the south-eastern side of Ironbark Creek. This change in access will potentially impact on the access to a small parcel of Crown land to the north of the proposal work
- The relocation of the bus stop located on Maitland Road opposite Hexham McDonalds to provide improved pedestrian connectivity.

5.5 Cumulative impacts

Cumulative impacts associated with construction operation of the proposal and other major projects in the area that are relevant to traffic and transport have been considered and are discussed in **Table 5.14.**

Table 5.14 Assessment of potential cumulative impact for relevant identified projects

Project (approval status)	**Relevance in consideration of cumulative impact**	**Potential cumulative impact**
M1 Pacific Motorway Extension to Raymond Terrace (In planning)	Located about one kilometre north of the proposal Potential to be consecutive (back to back) construction and concurrent (simultaneous) operation.	This road project is currently in planning. Transport plans to construct a new segment of the M1 Pacific Motorway between Tarro and Raymond Terrace. The M1 Pacific Motorway extension to Raymond Terrace has been captured in the traffic modelling as part of the 'Do Minimum' upgrades. The construction of the M1 Pacific Motorway extension will result in additional construction vehicles on Hexham Straight. These construction vehicle volumes are not expected to exceed capacity (including heavy vehicle capacity) of these state roads, however this will need to be confirmed by a Traffic Management Plan to be developed for the construction of the M1 Pacific Motorway Extension to Raymond Terrace. When both projects are operational, the M1 Pacific Motorway between Tarro and Raymond Terrace will reduce traffic at the A1 Pacific Highway and Maitland Road intersection improving traffic performance for Hexham Straight.
Lower Hunter Freight Corridor (in planning)	The investigation area includes Hexham at the south east of the proposal and M1 Pacific Motorway and Lenaghans Drive at the south west of the proposal	The Transport Lower Hunter Freight Corridor (LHFC) forms a part of the NSW Freight and Ports Strategy (NSW Government, 2018c) and in 2018 preliminary investigations were being carried out to assess options for a dedicated freight rail line between Fassifern and Hexham. No options were available on the website to review. An investigation areas figure between Fassifern and Hexham was available.

Project (approval status)	Relevance in consideration of cumulative impact	Potential cumulative impact
		The construction of a rail freight corridor would reduce the demand for road freight in the study area. As the scale and alignment of the Lower Hunter Freight Corridor are undetermined, the cumulative operational impact of this project is unknown. However, the proposed Hexham Straight widening design would allow for the LHFC.
Richmond Vale Rail Trail to Shortland, including Shortland to Tarro Bike Trail (In planning)	Runs parallel to Hexham Straight about one kilometre to the west	This project is not expected to result in cumulative negative impact with the proposal. The Richmond Vale Rail Trail to Shortland would encourage additional bicycle transport use within the study area. The Shortland to Tarro Bike Trail does not intersect with the proposal however it provides an additional alternative transport route for cyclists within the study area. Overall, the rail trail would have minimal impact on the operational traffic within the study area.

6. Mitigation measures

The management measures included in **Table 6.1** have been developed to specifically manage potential impact which has been predicted as a result of the proposed works. Where possible, the proposal has planned to avoid and minimise traffic and transport impact during the construction and operational phases. Despite this, the proposal would result in impact on the road network during construction and operation. Mitigation and management measures would be implemented to avoid, minimise and/or manage these impacts on the road network. These measures would be incorporated into relevant Environmental Management Plans (EMPs) during construction and operation of the proposal.

Table 6.1 Environmental management measures

Impact	Management measure	Responsibility	Timing
Impacts to traffic during construction	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the *Traffic Control at Work Sites Manual* (Roads and Traffic Authority, 2010) and *QA Specification G10 Control of Traffic*. The TMP will include: ▪ Confirmation of haulage routes ▪ Measures to maintain access to local roads and properties ▪ Site specific traffic control measures (including signage) to manage and regulate traffic movement ▪ Measures to manage temporary changes to the road network including use of barriers or lane occupancies ▪ Measures to maintain pedestrian and cyclist access (including communication, signage and alternative routes) ▪ Requirements and methods to consult and inform the local community of impacts on the local road network (including for out of hours work) ▪ Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads ▪ A response plan for any construction traffic incident ▪ Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic ▪ Any licences or permits required before starting activities ▪ Monitoring, review and amendment mechanisms.	Contractor	Prior to construction and during construction
Property access during construction	Property access will be maintained at all times during construction. Any changes to access arrangements or alternative access required during construction to be done in consultation with the landowner and will	Transport / Contractor	Detailed design, prior to construction,

Impact	Management measure	Responsibility	Timing
	provide the same equivalent pre-existing level of access unless agreed to. Consultation with landowners on property access to continue during detailed design and construction.		and during construction
Access	Where any legal access to property is permanently affected, arrangements for appropriate alternative access will be determined in consultation with the affected landowner and local road authority.	Contractor	Post-Construction
Pedestrian and cyclist access during construction	Pedestrian and cyclist access will be maintained throughout construction. Where maintaining access is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Contractor	Construction
Access to bus stops and public transport during construction	Access for public transport services, including school bus services, will be maintained where possible. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community.	Contractor	Prior to construction and during construction
Impacts to traffic from construction traffic	Haulage vehicle movements will be planned to minimise movements on the road network during the morning and evening peak periods where practicable.	Contractor	Prior to construction and during construction
Road closures, diversions or reconfigurations during construction	During any road closures, diversions or reconfigurations of the road and cycle network relevant consultation will be carried out with Transport, Local Council (where relevant), emergency services and public transport authorities.	Contractor	Prior to construction and during construction
Impacts to road users from changed traffic arrangements, traffic delays and disruptions during construction	Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays due to construction activities.	Contractor	Prior to construction and during construction
Damage or impacts on local road infrastructure during construction	Pre-construction and post construction road condition reports for local roads likely to be used for construction will be prepared. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made with the relevant road authority. Copies of road condition reports will be provided to the local roads authority.	Contractor	Prior to construction

7. Conclusion

7.1 Overview of impacts in the REF area

Transport has carried out extensive traffic modelling for the proposal for the opening year (2028) and future years (2038 and 2048). The construction, operational and cumulative impact of the proposal on traffic and transport have been identified from quantitative performance indicators such as network statistics, level of service and travel time and qualitative assessment. The main impacts are summarised as follows:

- Construction:
  - The staged construction program ensures Maitland Road remains open with two lanes in each direction during the extent of construction works, minimising disruptions to general traffic, public transport, pedestrian and cyclist, rail and maritime traffic movements
  - Travel time delays for road users arising from a reduction of the posted speed limit and additional vehicle movements to transport materials to site are to be expected
  - Minimal impacts to existing residential and commercial property accesses are expected during construction, although further stakeholder consultation is required to confirm property access requirements
- Operational:
  - The proposal would provide positive outcomes for the performance of the road network in each of the modelled scenarios across both the morning and evening peak periods. This is demonstrated by the improvements to network statistics such as average speed, delays and vehicle kilometres travelled
  - The proposal would result in improved outcomes for the road network as the increased capacity would cater for a higher volume of vehicles, while also maintaining faster travelling speeds for motorists
  - The operational performance at the main intersections in the study area shows an improved level of service as a result of the proposal
  - The provision of an additional lane and central median with a solid barrier requiring the removal of existing breaks in the median would result in improved safety outcomes for all road users as it would improve traffic flow, remove dangerous merging and U-turn locations resulting in more controlled movements. This is expected to reduce rear end crashes and run-off-road crashes
  - The proposal would have minor changes to access and the configuration of three private properties driveways
  - Operational impacts on public and active transport and maritime, rail and freight traffic would be minimal
- Cumulative:
  - The contribution of the proposal to the cumulative impact on transport and traffic in the area has been considered along with other major projects that are proposed or approved in the area in a high-level qualitative assessment and impacts are considered to be minor.

7.2 Overview of impacts in the EIS area

Impacts to traffic and transport in the EIS area are considered minor and include the following:

- During construction:
  - Loss of local access to the EIS area and informal fishing areas including an area of Crown land located to the south east of the Ironbark Creek Bridge and a small informal pullover area on the northern side of the bridge directly opposite to Sparke Street
  - The temporary use of access roads in the EIS area during construction by trucks and construction plant to enable road pavement, earthworks (embankment) and construction of piers to support the new bridge over Ironbark Creek
  - The relocation of the bus stop located on Maitland Road opposite Hexham McDonalds
- During operation:
  - The loss of the existing access road in EIS Area 1 located on the south- eastern side of Ironbark Creek. This change in access will potentially impact on the access to a small parcel of Crown land to the north of the proposal work
  - The relocation of the bus stop located on Maitland Road opposite Hexham McDonalds to provide improved pedestrian connectivity.

7.3 Proposal summary

The proposal would result in improved traffic performance outcomes across both the morning and evening peaks in 2028, 2038 and 2048. This includes improvements to network-wide speeds, travel times and intersection level of service. It would deliver improved safety across the network by providing safer roads that reduce the risk of fatal and serious injury crashes.

The proposal would integrate with the existing and planned transport network including rail, pedestrian, cycling and freight infrastructure. It also helps cater to the future demand generated from Tomago and Black Hill regions and ensures improved connectivity for all modes of transport. Overall, this proposal would positively contribute to the transport network in the Hunter region and fulfil the proposal objectives. In addition, the SEAR relating to traffic safety and access in the EIS area would be meet through the implementation of the TMP and mitigation measures developed to specifically manage potential impacts identified during construction and operation of the proposal and which are summarized in **Section 9**.

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9. Acronyms

Acronym	Definition
AADT	average annual daily traffic
CEMP	Construction environment management plan
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
EIS	environmental impact statement
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
FSI	fatal or serious injury
LEP	Local Environment Plan
LGA	Local government Area
LGA	Local government area
LoS	level of service
M12RT	M1 Extension to Raymond Terrace
NICB	Newcastle Inner City Bypass
NLTN	National Land Transport Network
NSW	New South Wales
ONS	Outer Newcastle Study
OSOM	oversize and overmass
PAH	Polycyclic Aromatic Hydrocarbons
PCU	Passenger Car Unit
PEI	Preliminary environmental investigation
POEO Act	*Protection of the Environment and Operations Act 1997*
REF	review of environmental factors
REF	Review of environmental factors
SEARs	Secretary's Environment Assessment Requirements
SEPP	State Environmental Planning Policy
Transport	Transport for NSW
VHT	vehicle hours travelled
VKT	vehicle kilometres travelled

Attachment A. Traffic Model Calibration and Validation Report ONS

Outer Newcastle Study

Traffic Model Calibration and Validation Report Rev02

ONS-TA-100-REP-002

Prepared for: Roads and Maritime Services
Date: 9 June 2018

DOCUMENT CONTROL

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Prepared for	Roads and Maritime Services			
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	Name	**Position**		
Originator	Jack Sandell	Transport Modeller		
Review	Meysam Amhadpour Christophe Steinbach	Associate Modeller Traffic Lead		
Approval	Craig Sutton	Project Manager		

Details of Revisions

Rev	Date	Description		
1	11/05/2018	Rev 1		
2	09/06/2018	Rev2		

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Appendices

Appendix A **RMS review comment**

Appendix B **Turn Counts**

Appendix C **Travel Time Results**

1. Introduction

1.1. Overview

SMEC has been engaged by Roads and Maritime Services (Roads and Maritime) on the Outer Newcastle Study (ONS), which will inform the strategic design, economic analysis and prioritisation of future state road upgrades in the study area.

The ONS study area (see section 1.5) comprises nationally significant freight routes, which converge at several key intersections. These routes and intersections currently experience significant congestion, constrain freight productivity and illustrate a low level of reliability.

Roads and Maritime has previously undertaken planning for both the M1 Pacific Motorway to Raymond Terrace project (currently at 80% concept design), and also the previous the Preliminary Outer Newcastle Study.

Roads and Maritime has made available to SMEC all previous studies and traffic models relevant for this study. As part of the engagement, SMEC has expanded, recalibrated and validated the previous MWH VISSIM model, using 2017 survey data. This updated model will be used to inform the strategic design and economic analysis of various road and intersection upgrades proposed within the study area. This model will also be used for any required modelling in the later stages of concept and detailed design.

1.2. Purpose of this report

The purpose of this *Traffic Model Calibration and Validation Report* is to demonstrate that the AM and PM 2017 base year models are calibrated to an acceptable standard, as outlined in the Roads and Maritime *Traffic Modelling Guideline,* Version 1, February 2013.

This *Traffic Model Calibration and Validation Report* contains but it is not limited to the following information:

- Definition of the modelled study area
- Available recorded data used in the calibration and validation process
- Any assumptions made during model development, including the OD matrix estimation process
- Assessment of model stability
- Assessment of calibration criteria
- Assessment of model validity

1.3. Modelling objective

The *Traffic Model Calibration and Validation Report* is aimed at supporting the following project objectives.

- Transfer the original MWH model from VISSIM 8.0-13 to 10.6.
- Extension of the traffic models to include three additional signalised intersections, Old Maitland Rd/Pacific Hwy, Inner City Bypass/Pacific Hwy, and Wallsend Rd/Pacific Hwy.
- Update ,calibrate and validate the traffic models using new 2017 survey data. This includes revisions of the original demand matrices produced by MWH.
- Application of detailed VISSIM microsimulation model to assess the performance of various projects' and project combinations.

- Inform the *Traffic and Transport Assessment Report*, which in turn informs the options design process, as well as providing inputs for the economic analysis of various projects and project combinations.

1.4. Scope of work

SMEC has developed a comprehensive approach to meet the modelling objectives of this study. It involves analysis of background information, traffic data analysis, development of a road based VISSIM traffic model, and application of the model to assess the future network performance of future upgrade scenarios. The overall traffic modelling process is shown graphically in Figure 1-1.

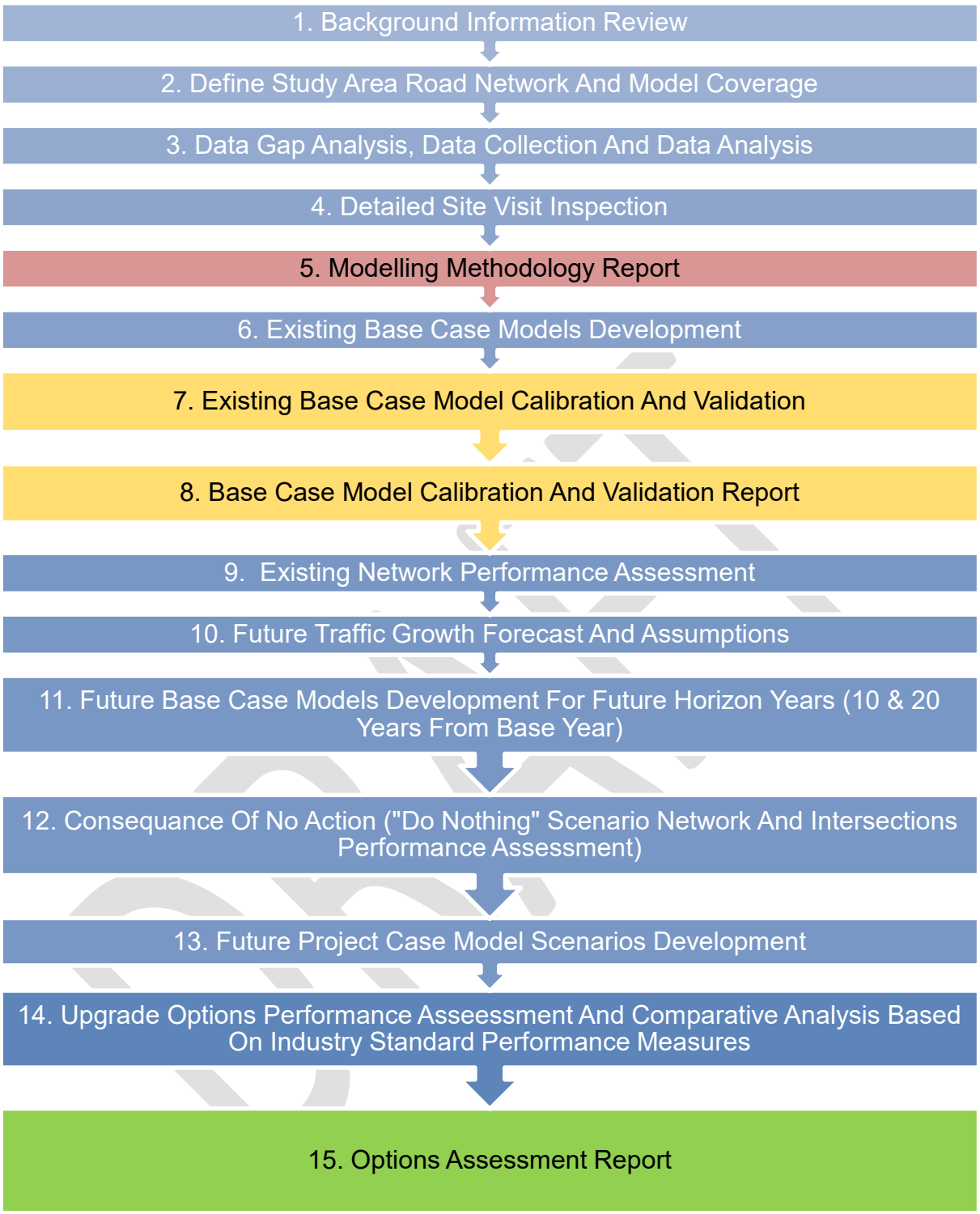

Figure 1-1 Project methodology

1.5. Study area

Figure 1-2 illustrates the VISSIM model network coverage, adopted for this project, as well as the locations of all intersections and roads included in the model.

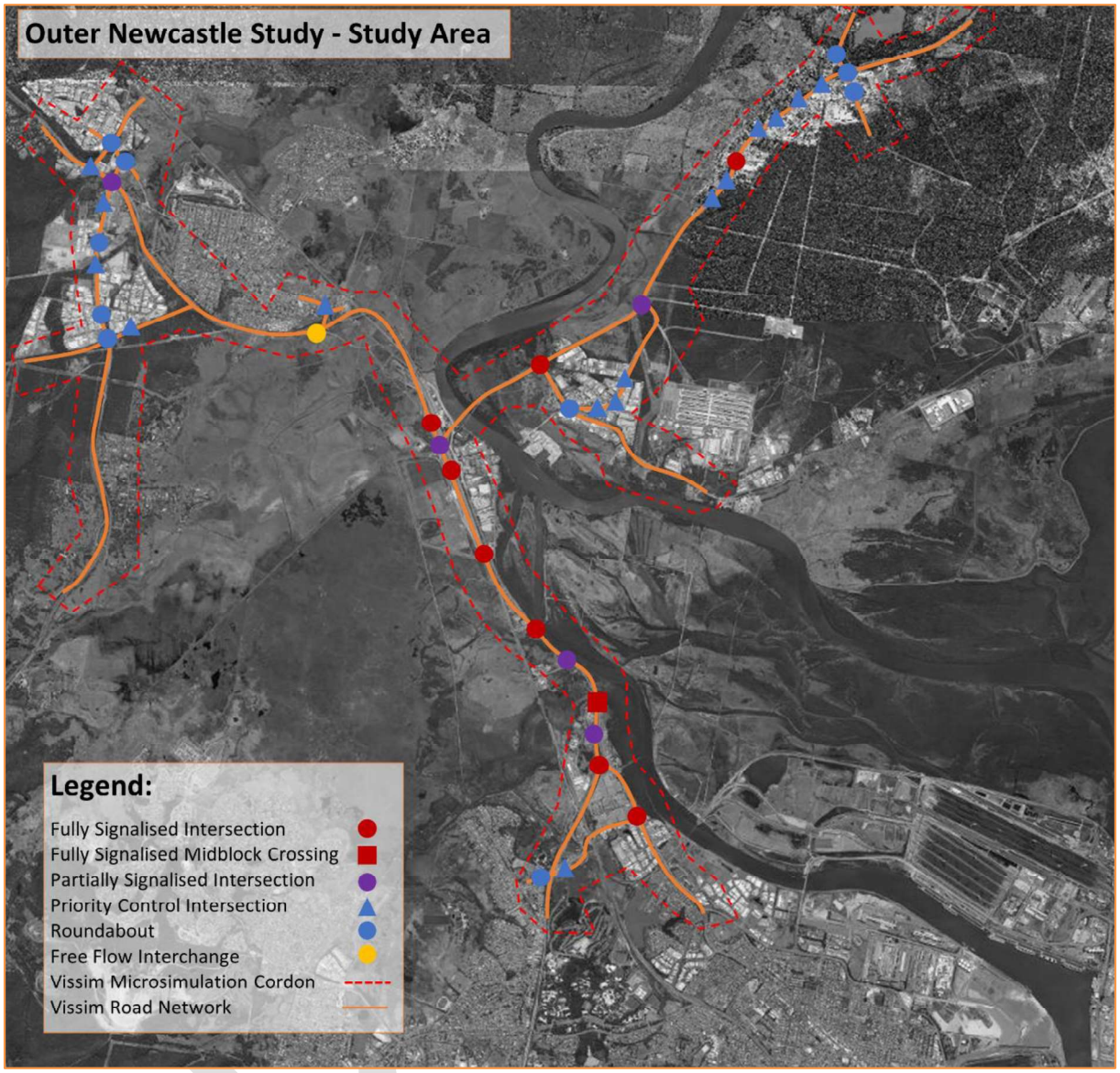

Figure 1-2 Study area

1.6. Report outline

In general, this report is structured with the following key sections

- Existing conditions
- Model assumptions
- Model stability
- Model calibration and validation
- Conclusion.

2. Existing conditions

2.1. Traffic surveys

There were six main sources of traffic data were used for this project. These include:

- Classified vehicle turn counts survey data performed on the 18/10/17.
- Classified vehicle midblock counts traffic survey data performed between 10/10/17 and 24/10/17.
- Queue length surveys performed on the 18/10/17.
- Travel time surveys performed on the 18/10/17 and 19/10/17.
- Origin-destination survey performed on the 7/11/17.
- SCATS detector volume, and phase timing data collected on the 18/10/17.

The traffic data was supported by the provision of signalised intersection plans provided by RMS, as well as the original VISSIM OD demand matrices developed by MWH.

Figure 2-1 and Table 2-1 below show the locations of traffic surveys.

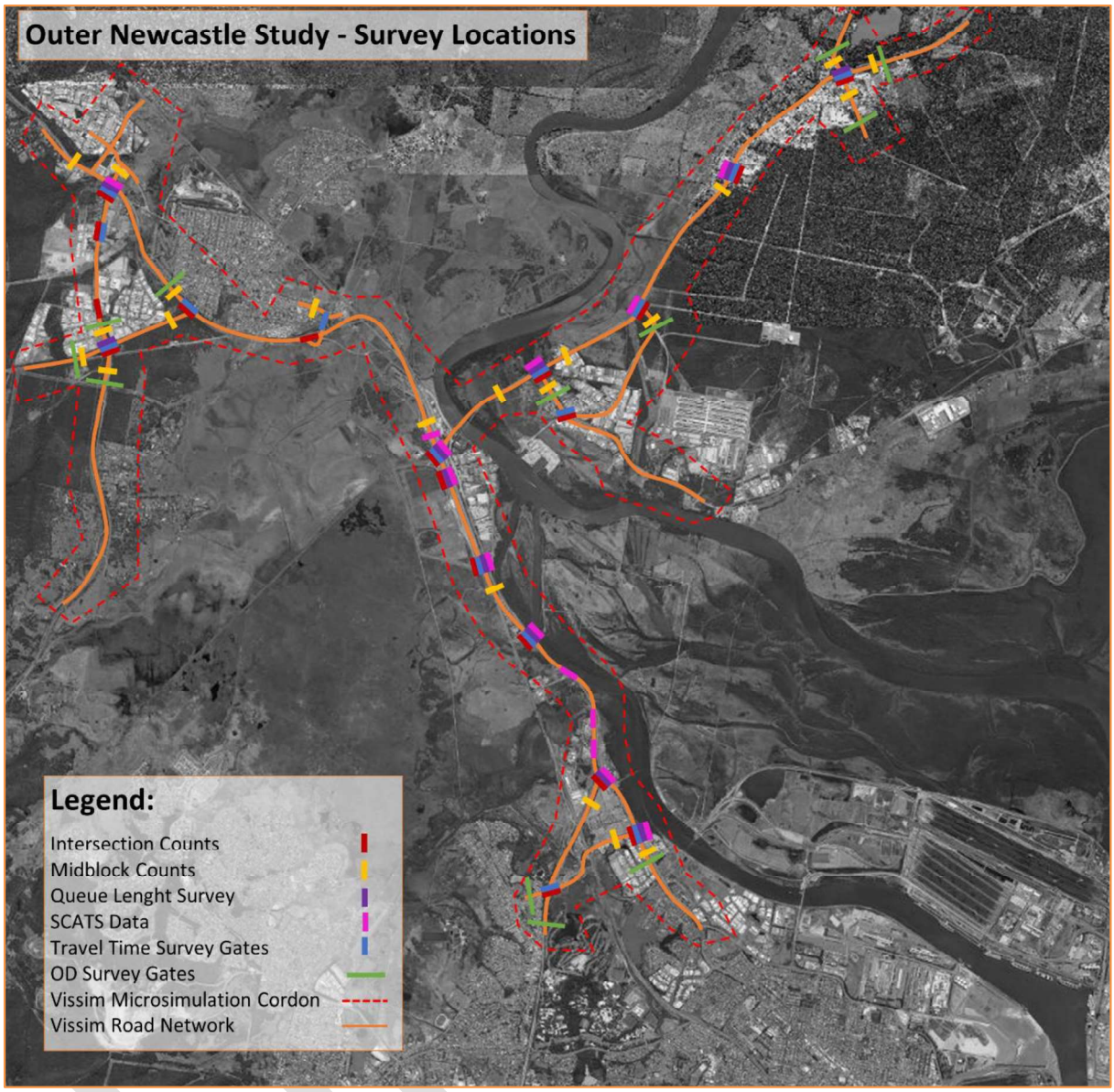

Figure 2-1 – Traffic Survey Locations

Table 2-1 Traffic Survey Locations

Survey Type	ID	Location	Date
Classified Intersection Turning Volumes	1	John Renshaw Dr/ Weakleys Dr	18/10/2017
	2	Yangan Dr/ Weakleys Dr	
	3	Canavan Dr/ Weakleys Dr	
	4	New England Hwy/ Weakleys Dr	
	5	New England Hwy/ John Renshaw Dr	
	6	New England Hwy/ Anderson Dr	
	7	Pacific Hwy/ Maitland Rd	
	8	Pacific Hwy/ Tomago Rd	
	9	Old Punt Rd/ Tomago Rd	

Survey Type	ID	Location	Date
	10	Old Punt Rd/ Pacific Hwy	
	11	Hank St/ Pacific Hwy	
	12	Masonite Rd/ Pacific Hwy	
	13	Old Maitland Rd/ Maitland Rd (North End)	
	14	Old Maitland Rd/ Maitland Rd (South End)	
	15	Shamrock St/ Maitland Rd	
	16	Inner City Bypass/ Maitland Rd	
	17	Wallsend Rd/ Maitland Rd	
Travel Time Survey	1	New England Hwy/Weakleys Dr	
	2	Weakleys Dr/Canavan Dr	
	3	New England Hwy/John Renshaw Dr	
	4	Weakleys Dr/John Renshaw Dr	
	5	New England Hwy/Anderson Dr	
	6	Maitland Rd/Pacific Hwy	
	7	Pacific Hwy/Tomago Rd	
	8	Tomago Rd/Old Punt Rd	
	9	Maitland Rd/Old Maitland Rd (South)	
	10	Pacific Hwy/Old Punt Rd	
	11	Maitland Rd/Shamrock St	
	12	Pacific Hwy/Hank St	
	13	Pacific Hwy/Masonite Rd	
	14	Pacific Hwy/Inner City Bypass	
	15	Sandgate Rd/Wetlands Pl	
	16	Maitland Rd/Wallsend Rd	
Classified Midblock Speed and Volume Survey	1	M1, South of John Renshaw Dr.	10/10/17-24/10/17 24hr
	2	John Renhaw Dr, West of Weakleys Dr.	10/10/17-24/10/17 24hr
	3	Weakleys Dr, North of John Renshaw Dr.	10/10/17-24/10/17 24hr
	4	New England Hwy, West of Thornton Rd.	11/10/17 - 23/10/17 24hr
	5	Weakleys Dr, North of New England Hwy.	10/10/17 - 23/10/17 24hr
	6	New England Hwy, West of John Renshaw Dr.	10/10/17 - 23/10/17 24hr
	7	John Renshaw Dr, West of New England Hwy.	11/10/17 - 23/10/17 24hr
	8	Anderson Dr, West of New England Hwy.	11/10/17 - 23/10/17 24hr
	9	New England Hwy, North of Pacific Hwy.	11/10/17 - 24/10/17 24hr

Survey Type	ID	Location	Date
Classified Midblock Speed and Volume Survey (cont.)	10	Pacific Hwy, 1km North of the Hunter River Bridge	11/10/17 - 23/10/17 24hr
	11	Tomago Rd, East of Pacific Hwy.	12/10/17 - 22/10/17 24hr
	12	Pacific Hwy, North of Tomago Rd.	11/10/17 - 23/10/17 24hr
	13	Old Punt Rd, South of Pacific Hwy.	10/10/17 - 22/10/17 24hr
	14	Pacific Hwy, South of Hank St.	11/10/17 - 23/10/17 24hr
	15	Adelaide St, West of Pacific Hwy.	10/10/17 - 23/10/17 24hr
	16	Masonite Rd, East of Pacific Hwy.	10/10/17 - 23/10/17 24hr
	17	Pacific Hwy, North of Masonite Rd.	11/10/17 - 23/10/17 24hr
	18	Maitland Rd, South of Old Maitland Rd (Hexham)	11/10/17 - 23/10/17 24hr
	19	Newcastle Inner City Bypass, South of Maitland Rd.	12/10/17 - 22/10/17 24hr
	20	Sandgate Rd, South of Maitland Rd.	10/10/17 - 22/10/17 24hr
	21	Maitland Rd, South of Sandgate Rd.	11/10/17 - 22/10/17 24hr
Queue Length Survey	1	John Renshaw Dr/ Weakleys Dr	18/10/2017
	4	New England Hwy/ Weakleys Dr	
	7	Pacific Hwy/ Maitland Rd	
	8	Pacific Hwy/ Tomago Rd	
	11	Hank St/ Pacific Hwy	
	12	Masonite Rd/ Pacific Hwy	
	13	Old Maitland Rd/ Maitland Rd (North End)	
	14	Old Maitland Rd/ Maitland Rd (South End)	
	15	Shamrock St/ Maitland Rd	
	16	Inner City Bypass/ Maitland Rd	
	17	Wallsend Rd/ Maitland Rd	
OD Survey Gates	1	M1 Pacific Mwy, south of Lenaghans Dr, Black Hill	7/11/2017
	2	John Renshaw Dr, west of M1 Mwy, Black Hill	
	3	Weakleys Dr, north of John Renshaw Dr, Beresfield	
	4	New England Hwy, west of John Renshaw Dr, Tarro	
	5	Adelaide St, west of Pacific Hwy, Heatherbrae	
	6	Pacific Hwy, north of Masonite Rd, Raymond Terrace	
	7	Masonite Rd, east of Pacific Hwy, Heatherbrae	
	8	Old Punt Rd, east of Pacific Hwy, Tomago	
	9	Tomago Rd, east of Pacific Hwy, Tomago	
	10	Maitland Rd, east of Wallsend Rd, Shortland	

Survey Type	ID	Location	Date
OD Survey Gates (cont.)	11	Newcastle Inner City Bypass, south of Shortland Interchange	
	12	Sandgate Rd, south of Inner City Bypass	

2.2. SCATS Traffic Signal data

SMEC received SCATS traffic signal data to assist in the development of the VISSIM traffic models. These included:

- Signal Historical Operation Data – 18/10/17
- Recorded Detector Volumes – 18/10/17
- Site Specific notes detailing operational anomalies
- TCS Plans

SCATS data has been made available for the following sites:

Table 2-2 Available SCATS Data

TCS ID	Intersection
TCS: 3289	New England Hwy/ Weakleys Dr
TCS: 722	Pacific Hwy/ Maitland Rd
TCS: 2557	Oak Resturant/New England Hwy
TCS: 4063	Pacific Hwy/ Tomago Rd
TCS: 4064	Old Punt Rd/ Pacific Hwy
TCS: 4328	Hank St/ Pacific Hwy
TCS: 4332	Old Maitland Rd/ Maitland Rd (North End)
TCS: 4018	Old Maitland Rd/ Maitland Rd (South End)
TCS: 3470	Shamrock St/ Maitland Rd
TCS: 4393	Inner City Bypass/ Maitland Rd
TCS: 876	Wallsend Rd/ Maitland Rd
TCS: 3946	Maitland Rd/ Sparke St
TCS: 4019	Maitland Rd & U turn bay
TCS: 4080	Maitland Rd & Old Maitland Rd West

3. Model assumptions

3.1. Modelling platform

VISSIM Version 10.00-06 was used for the model development. As requested by Roads and Maritime, VISVAP was also applied for traffic signal coding.

3.2. Time period

The base case model represents existing 2017 traffic conditions for:

- Three hours in the morning (AM) peak period between 6:00 am and 9:00 am for an average weekday condition
- Three hours in the afternoon (PM) peak period between 3:00 pm and 6:00 pm for an average weekday condition

As recommended by the modelling guidelines, each model was also built with a 45-minute warm-up period to ensure a good representation of traffic conditions at the beginning of the modelling period. In addition, a 30-minute cool down period was also included to replicate the reduced traffic demand after the peak period.

3.3. Assignment type

Vehicle Dynamic assignment has been used in the model.

3.4. Vehicle types

The demand matrices were estimated separately for each modelled hour and for the following vehicle types:

- Cars/ Light vehicles
- Heavy vehicles.

3.5. Traffic zones/input

The model has been coded with 47 zones, as shown in the below in Figure 3-1.

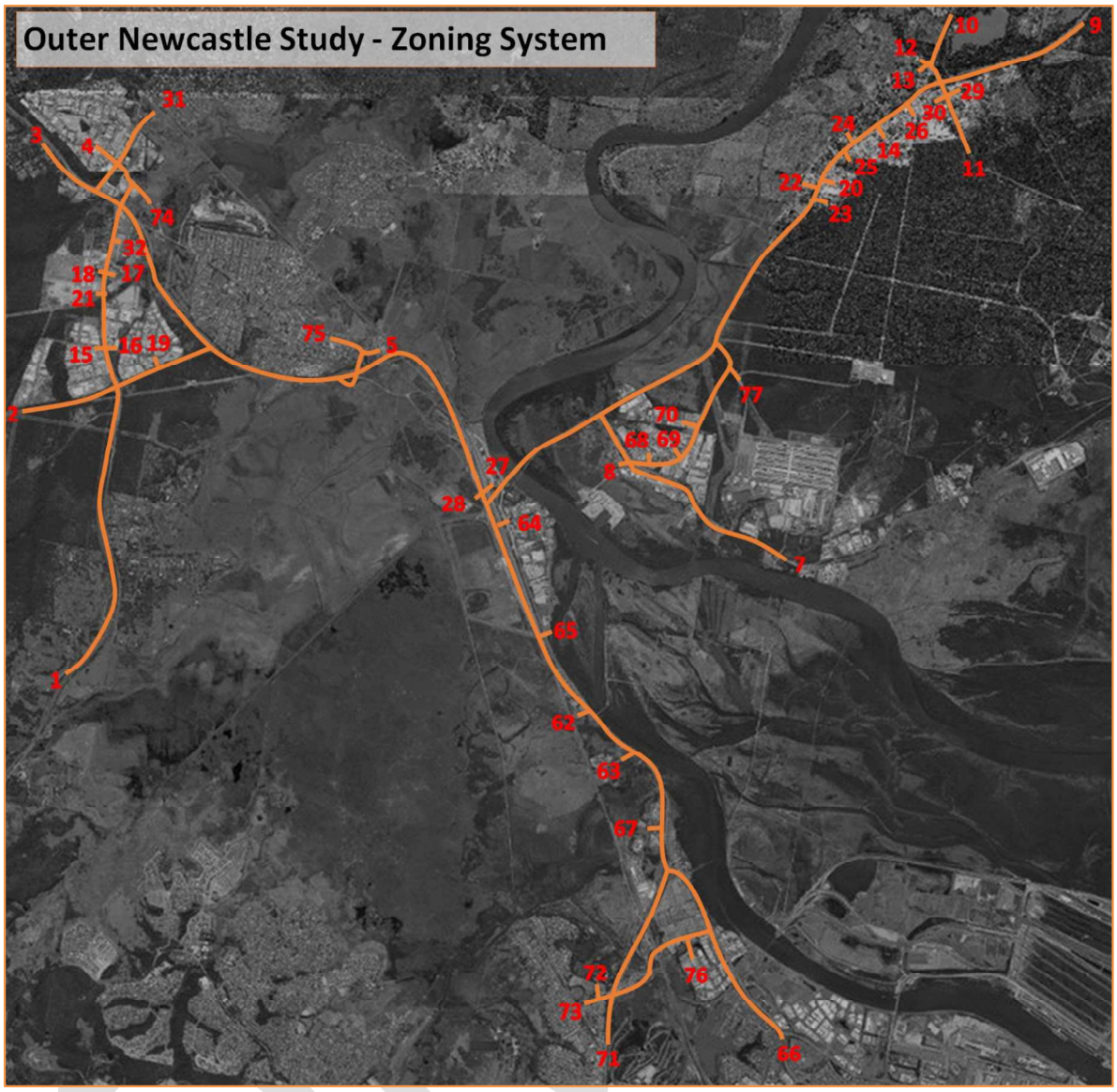

Figure 3-1 Zone layout

3.6. Speed profiles

Speed profiles have been coded as per the received MWH model. Further review of speed limits have been also completed to match them to the posted speed limits.

3.7. School zones

A School Zone has been identified on the southern end of Anderson Dr, outside Tarro Public School. This school zone is operational between 8:00-9:30am and 2:30-4:00pm, and has been included in the model. The exact location is shown in Figure 3-2 School zones

Figure 3-2 School zones

3.8. Traffic signals

As part of the modelling process, SMEC completed signals coding with actuation algorithm using VISVAP. The coded traffic signals run on a fixed cycle time with demand actuated phase timing. These parameters were calibrated against signal data as well as site specific notes, provided by the RMS.

Fixed offset times, updating every hour as the cycle time changes, are used to achieve coordination between signals where necessary. Based on the received SCATS setting and site specific notes , offsets are in place between:

- Maitland Rd & Old Maitland Rd West (TCS 4080)
- New England Highway & Pacific Highway (TCS 722)
- New England Highway & Oak Access (TCS 2557)

Information provided also states that Maitland Rd & Shamrock St (TCS 3470) and Maitland Rd & Old Maitland Rd East (TCS 4332) are coordinated off peak, however during the peak hours they are divorced to take into account the long and unmatched cycle times.

3.9. Public transport

Existing bus routes and bus frequencies were included in the model based on the available public transport information sourced from *http://www.transportnsw.info/.* Figure 3-3 shows the public transport network identified within the study area.

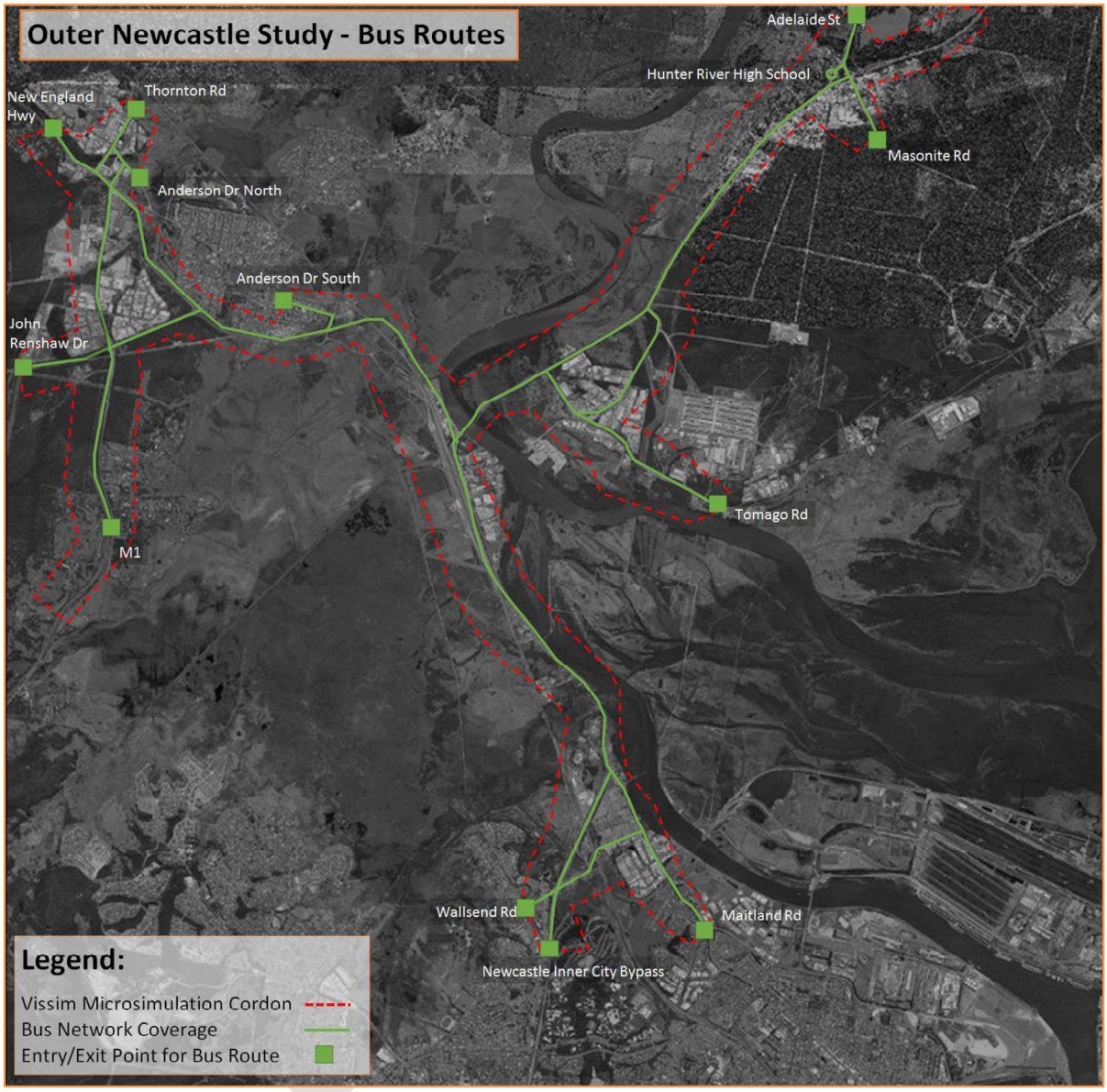

Figure 3-3 Bus Network Coverage within Study Area

Table 3-1 summarises bus services identified within the study area, the routes that they traverse, as well as the total number of services entering the model within the 3-hour peak periods. A total of 64 services operate within the area, travelling along 27 unique routes.

Table 3-1 Bus frequencies and routes

Route Description.	Route #	3hr Volume			
		AM		PM	
		NB/WB	SB/EB	NB/WB	SB/EB
Between Maitland Rd & Adelaide St via Tomago Rd	140	6	0	0	6
	1292				
Between Wallsend Rd & Maitland Rd	47	3	4	4	3
	739				
	6277				
	6242				
Between Maitland Rd & Adelaide St	1304	0	9	8	0
	1272				
	1323				
	140				
	1291				
	1311				
	1481				
Between Maitland Rd & Anderson Dr South	1223	0	3	1	0
	2371				
	1501				
	2381				
Between Maitland Rd & Thornton Rd Via New England Hwy and Weakleys Dr	2373	0	0	1	0
Between Wallsend Rd & Anderson Dr South	2522	0	1	1	0
	2471				
Between Wallsend Rd & Adelaide St	1492	0	0	1	0
Between Newcastle Inner City Bypass & Anderson Dr South	2821	1	0	0	0
Between Newcastle Inner City Bypass & Adelaide St	1221	1	1	0	0
Between Newcastle Inner City Bypass & John Renshaw Dr	160	1	1	0	0
Between Masonite Rd & Adelaide St	135	5	1	0	2
	1321				
	1231				
	135				
	1211				
	1342				
	1314				
Adelaide St Loop via Hunter River High School	1271	0	4	0	1
	0072				
	1201				
	1381				
	1631				
Between Adelaide St & Anderson Dr South	1261	0	1	0	0
Between Adelaide St & Tomago Rd South via Old Punt Rd	1262	0	0	0	1
Between Anderson Dr North & New England Hwy via Weakleys Dr	181	0	9	0	8
	145				
	2402				
	1261				
	1223				
	1501				
	2381				
	2223				
Between Anderson Dr North & Thornton Rd	2202	1	0	3	0
	2622				
	2522				
	1378				
Between Anderson Dr North & M1 via Weakleys Dr	2652	0	0	0	1
Between John Renshaw Dr & Anderson Dr North via Weakleys Dr	2392	1	0	0	0
Between M1 & New England Hwy via John Renshaw Dr	1511	1	0	0	0
Between M1 & Anderson Dr South	2611	0	2	0	1
	1151				
	1378				
Between New England Hwy & Anderson Dr North via Thornton Rd	145	5	0	6	0

	181				
Between New England Hwy & Thornton Rd	182	2	0	3	0
Between New England Hwy & Maitland Rd	2611	0	1	0	0
Between New England Hwy & M1 via Weakleys Dr	1513	0	0	0	2
	6635				
Between New England Hwy & Adelaide St	1294	0	0	0	1
Between New England Hwy & Thornton Rd via Weakleys Dr	182	0	5	0	6
	2601				
	1441				
	1293				
	2416				
	2514				
Between Thornton Rd & Anderson Dr North	2371	0	10	0	1
	2201				
	2511				
	2471				
	2281				
	2551				
	2401				
	1151				
	2622				
	2372				
	2634				

3.10. Trip Table Matrix Estimation

To develop the trip matrix, the original matrices from the MWH model were furnessed against the counts taken as part of the 2017 traffic surveys. The matrices were then further refined as part of the calibration process.

3.11. Pedestrians and cyclists

Based on provided SCATS phasing data, pedestrian specific phases are rarely called within the AM and PM peaks. It was deemed that pedestrian traffic would have little impact on signal operation, and hence pedestrians have been omitted from this model to aid simplicity, and reduce variability in results.

3.12. Traffic profile

Traffic profiles were developed for the outbound volumes across both the AM and PM peak periods, for each zone, reflecting the volumes observed in the traffic counts the 2017 survey data. Profiles for the overall study area have been divided into three sectors (see Figure 3-4) and are shown in Figure 3-5 AM traffic profile and Figure 3-6 PM traffic profile.

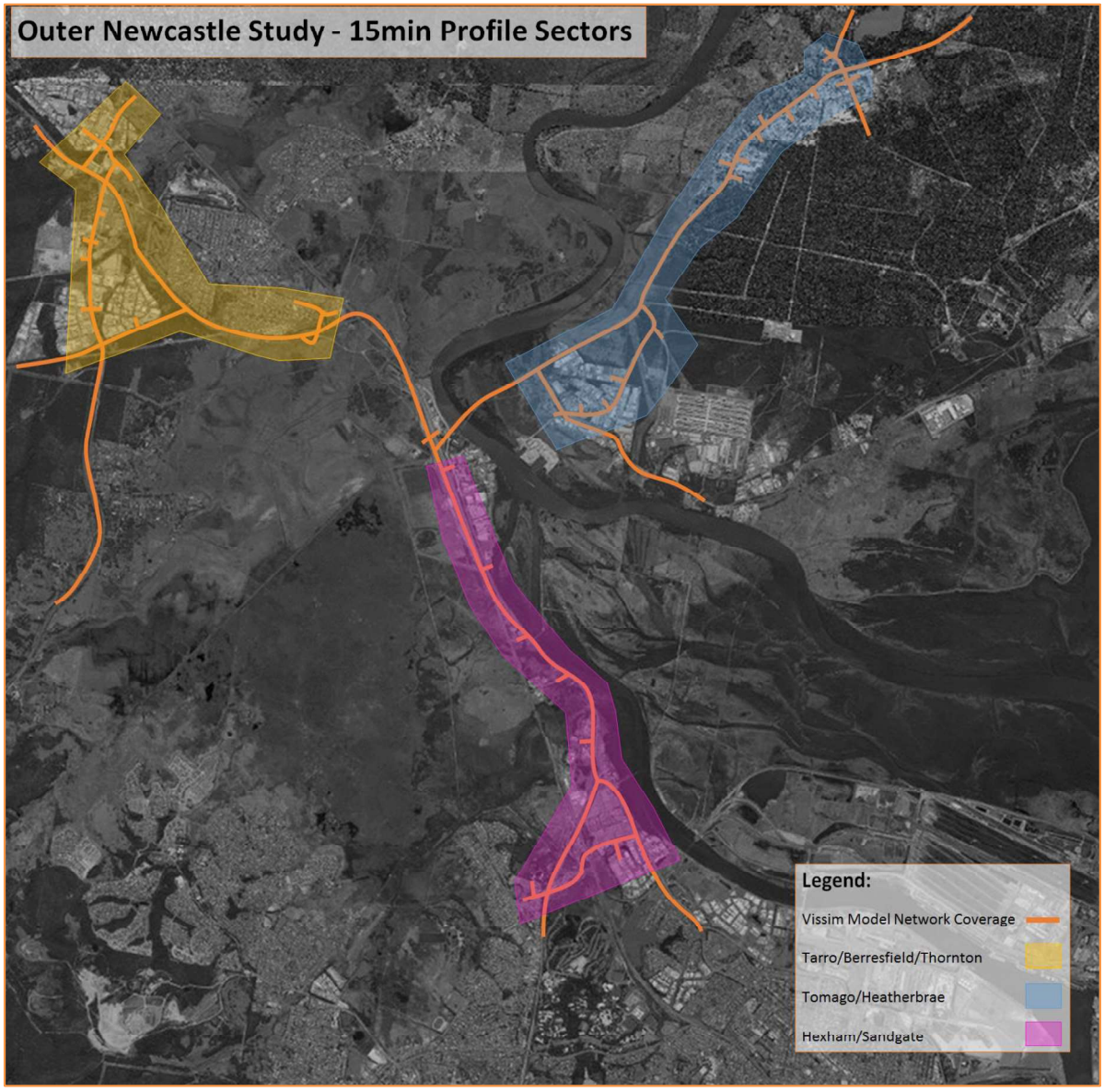

Figure 3-4. Traffic profile sectors

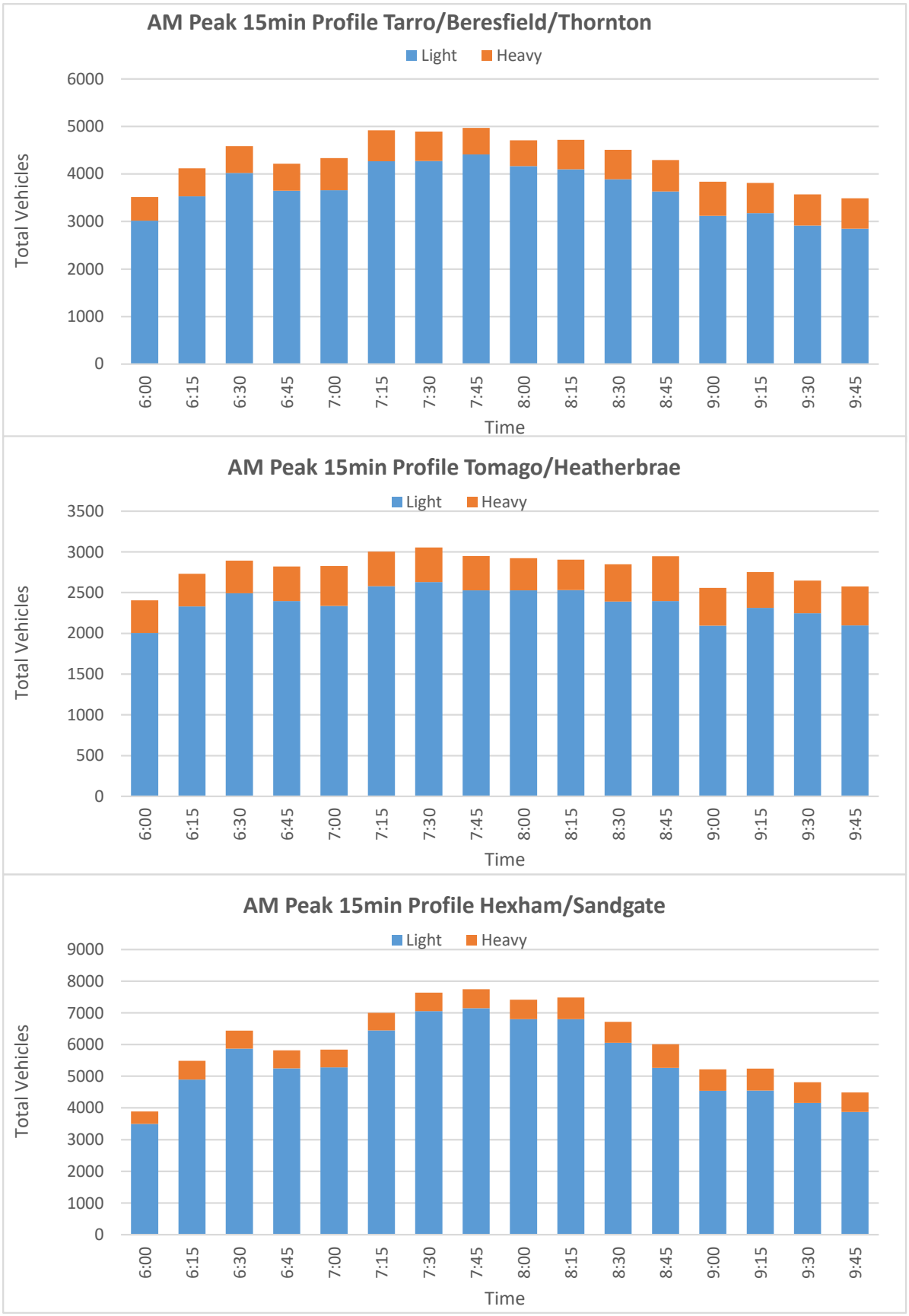

Figure 3-5 AM traffic profile

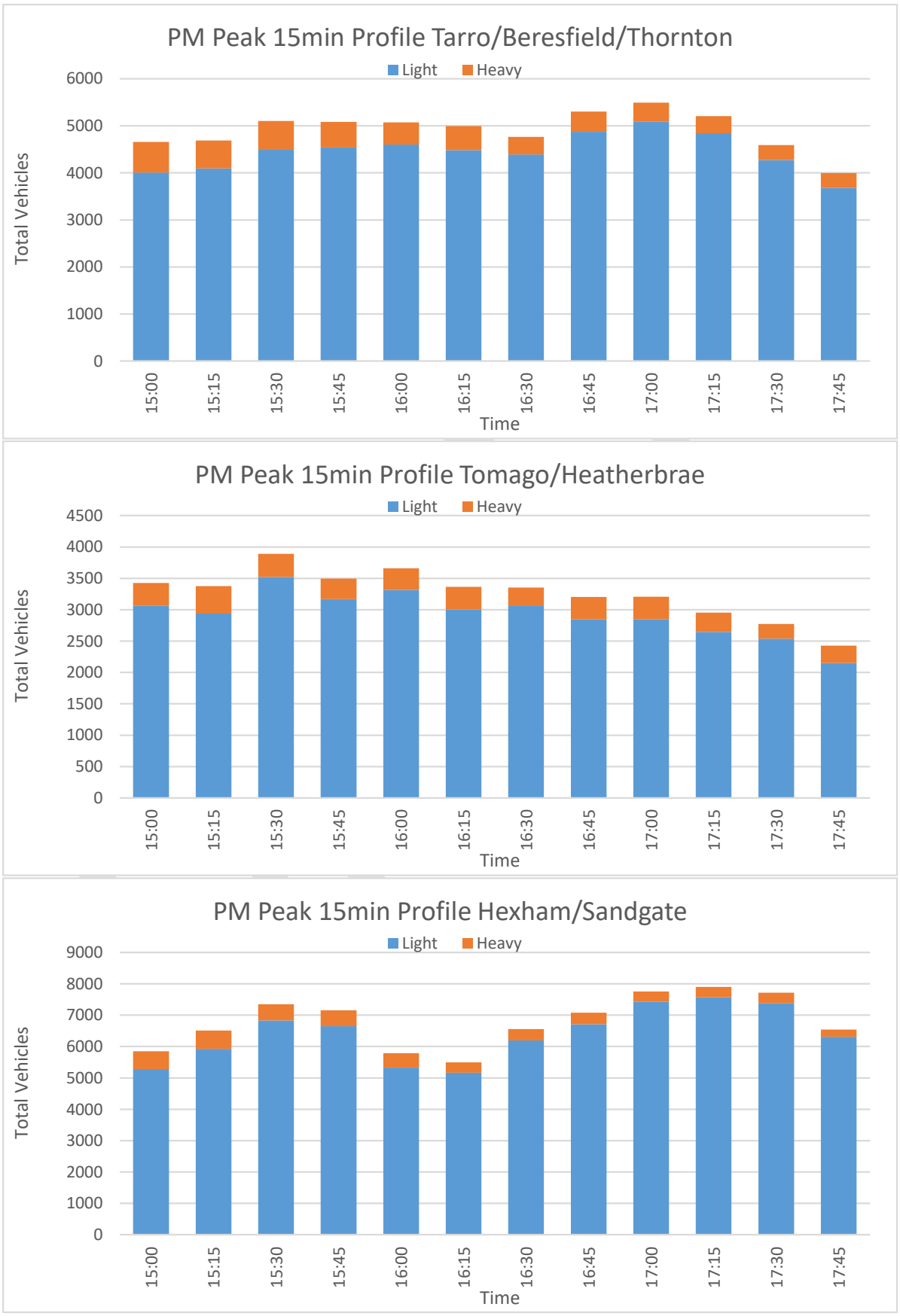

Figure 3-6 PM traffic profile

3.13. Behaviour parameters

In general, and in order to calibrate the traffic model network for the observed traffic conditions, default VISSIM criteria were applied, however where necessary, defaults values were adjusted to reflect the observed area specific behaviours. Such values include:

- *Next lanes:* Forcing vehicles into the correct lanes and avoiding the attractive but incorrect lanes, which the vehicles should not move into
- *Emergency Stop distance* and *Lane Change distance:* Adjusting visibility distance to improve lane change behaviour and reduce unrealistic congestion
- *Zone Release Speed:* this value is mainly adjusted to ensure vehicles commence their trip at the posted speed limit and at the expected travel speed
- *Additive* and *Multiplic part of safety distance:* these values are adjusted to match driver's reaction times and headways to adjust the capacity of links in the models and reflect observed driver behaviour
- *Waiting time before diffusion:* waiting time before diffusion was increased to 150 seconds in order to match the max cycle times
- *Min. Headway* and *Min. Gap Time*: these values allow vehicles to judge whether there is a sufficient gap at priority intersections
- *Cooperative lane change:* Adjusts whether or not vehicles will brake to allow other vehicles to enter into their lane.

4. Model stability

Similar to other main stream microsimulation packages, VISSIM micro-simulation models use random number sequences to produce a small level of variability within each simulation to reflect the range of behaviours that are exhibited in the real world.

The VISSIM software package allows the modeller to provide an initial seed value for each model run. The seed value affects the generation of the random numbers that influence the model operation and variability. Therefore, each time the model runs with a different seed value some slightly different set of outputs is generated. It is generally expected that these outputs would be very similar, but not identical, and it is an analysis of the variability between these results that indicates the stability of the model.

According to the Roads and Maritime modelling guidelines, there are a number of ways in which the stability of a model across a number of seed runs can be demonstrated. Roads and Maritime suggests that at least one of the following techniques to be graphically presented within the base model reporting:

- Total kilometres in network or Vehicle Kilometre Travel (VKT) results
- Total travel time in network or Vehicle Hour Travel (VHT) results.

In order to analyse the model stability for each peak period models, SMEC assessed model stability across five seed values. The results from different seed values were produced for number of vehicles in the network for regular intervals throughout the simulation.

Figure 4-1 and Figure 4-2 show the AM and PM peak variation in VKT and VHT values in the network with five different seeds[1]. The model was run for five 'seed' values as per the modelling guidelines. The five seeds values were 560, 28, 7771, 86524, and 2849.

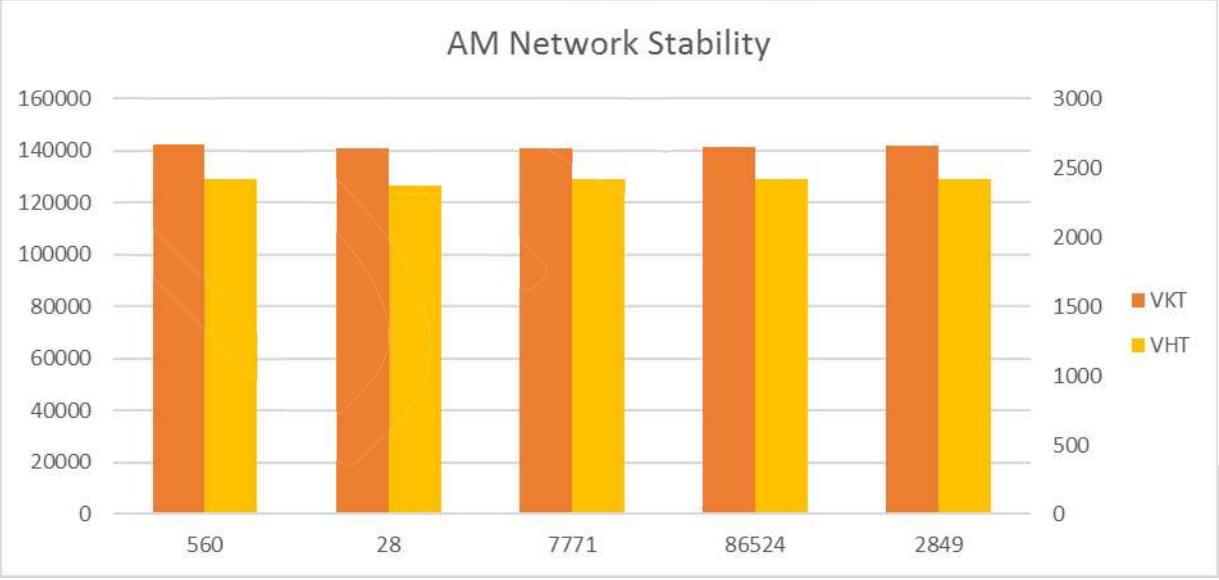

Figure 4-1 AM Network Stability

[1] Seed value specifies the value used by the random number generator. Identical networks simulated using the same processor will return the same results using the same seed value.

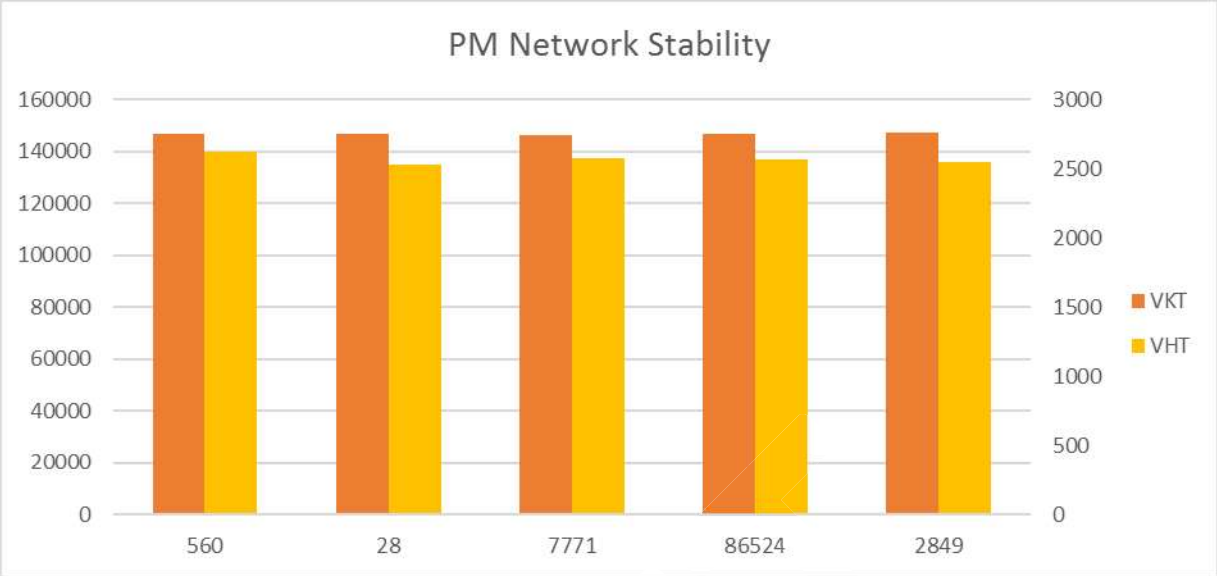

Figure 4-2 PM Network Stability

5. Model calibration and validation

5.1. Traffic Models Calibration

5.1.1. Overview

Model calibration involves matching observed traffic volumes with the modelled traffic flows to ensure that the base model is representative of the existing traffic conditions.

Throughout this project, model calibration criteria given in the Roads and Maritime *Traffic Modelling Guideline,* Version 1, February 2013, were used for the base case model calibration and validation purpose.

To further ensure the models are a good fit for the network, the base models were audited by the RMS with comments received on 28 May 2018. A list of comments and responses are provided in Appendix A.

5.1.2. Network calibration

The traffic models were calibrated to the observed vehicle movements and behaviours within the traffic network. During network calibration process, the Vissim default time step value of ten was adopted.

In general, to calibrate the traffic model network for the observed traffic conditions, default VISSIM criteria were applied, however where necessary, defaults values were adjusted to reflect the observed area specific behaviours.

5.1.3. Calibration criteria

Model calibration criteria given in the Roads and Maritime *Traffic Modelling Guideline, Version 1, and February 2013* were used for the base case model calibration and validation purpose.

Considering the nature and the size of the project and the agreed model network coverage included in the micro-simulation model, the entire model was treated under Core area calibration targets which tends to more conservative targets to meet.

Road and Maritime's calibration criteria for this project is shown below in Table 5-1.

Table 5-1 Calibration criteria (standard-network wide)

Network Criteria	Target
Link and turn volumes: GEH < 5	≥ 85%
Link and turn volumes: 5 < GEH < 10	≤ 15%
Link and turn volumes: GEH ≥ 10	0%
Link and turn volumes: R^2	>0.95
Core Criteria	**Target**
Flows less than 100 vehicle per hour	to be within 10 vehicles of observed value
Flows between 100 and 1000 vehicle per hour	to be within 10 per cent of observed value
Flows between 1000 and 2000 vehicle per hour	to be within 100 vehicles of observed value
Flows larger than 2000 vehiles per hour	to be within 5 per cent of observed value

Source: RMS Modelling guideline 2013

5.1.4. Core area definition

It was agreed with the RMS that the following intersections were considered part of the core area:

- Maitland Road/Pacific Highway
- Pacific Highway/John Renshaw Drive/Weakleys Drive
- New England Highway/Weakleys Drive
- Pacific Highway/Tomago Road
- Pacific Highway/Masonite Road.

5.1.5. Intersection turn flow calibration results

Table 5-2 AM Peak Calibration results (median seed 2849) and Table 5-3 PM Peak Calibration results (median seed 28) summarise network wide model calibration results for each modelled hour for the median seed in AM and PM peak periods respectively.

Table 5-2 AM Peak Calibration results (median seed 2849)

GEH value/criteria	Target	Achieved AM peak (6:00am-7:00am)		Achieved AM peak (7:00am-8:00am)		Achieved AM peak (8:00am-9:00am)	
		Number of turns	(%)	Number of turns	(%)	Number of turns	(%)
GEH < 5	≥ 85%	133	100%	133	100%	133	100%
5 ≤GEH ≤ 10	< 15%	0	0%	0	0%	0	0%
GEH > 10	0%	0	0%	0	0%	0	0%
R^2	>0.95	1.00		1.00		1.00	
Flows < 99	to be within 10 vehicles	16	100%	15	100%	16	100%
99≤Flows <1000	to be within 10 per cent	26	100%	28	100%	28	100%
1000≤Flows <2000	to be within 100 vehicles	6	100%	4	100%	4	100%
Flows > 2000	to be within 5 per cent	0	100%	1	100%	0	100%

Table 5-3 PM Peak Calibration results (median seed 28)

GEH value/criteria	Target	Achieved AM peak (6:00am-7:00am)		Achieved AM peak (7:00am-8:00am)		Achieved AM peak (8:00am-9:00am)	
		Number of turns	(%)	Number of turns	(%)	Number of turns	(%)
GEH < 5	≥ 85%	133	96%	132	99%	131	99%
5 ≤GEH ≤ 10	< 15%	4	4%	1	1%	1	1%
GEH > 10	0%	0	0%		0%	0	0%
R^2	>0.95	1.00		1.00		1.00	
Flows < 99	to be within 10 vehicles	13	100%	14	100%	16	100%
99≤Flows <1000	to be within 10 per cent	29	100%	28	100%	27	100%
1000≤Flows <2000	to be within 100 vehicles	6	100%	6	100%	4	100%
Flows > 2000	to be within 5 per cent	0	100%	0	100%	1	100%

Detailed model calibration results for AM and PM Peak are reported in **Appendix B**.

5.1.6. R^2 plots (observed vs modelled intersection turn flows)

R^2 is a statistical measure which indicates how well a regression line approximates observed data points. R^2 is a descriptive measure between zero and one (zero for worst and 1 for the best match). R^2 plots are based on 50 turning movements (observed vs modelled) for each modelled hour in AM and PM peak period for the entire modelled road network.

Figure 5-1 to Figure 5-6 show the R^2 plots for each modelled hour in AM and PM peak period for the area network.

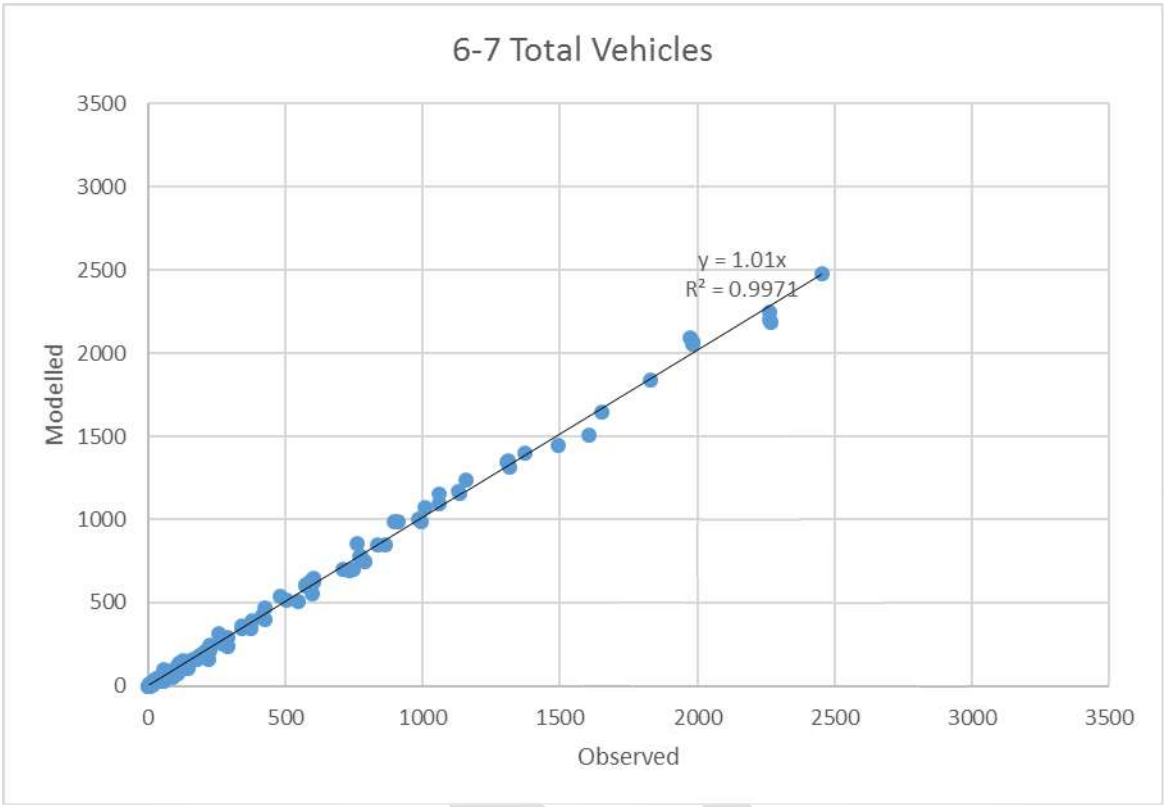

Figure 5-1 Turn Calibration 6-7 AM (median seed: 7771)

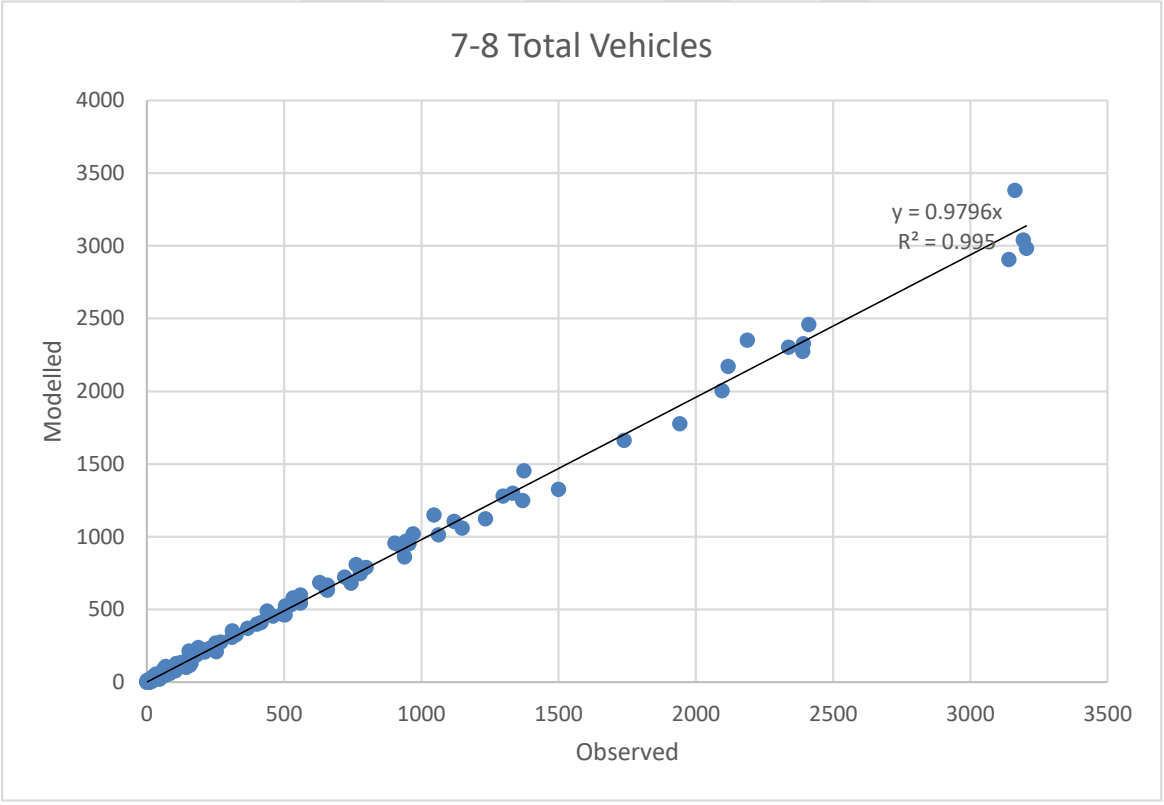

Figure 5-2 Turn Calibration 7-8 AM (median seed: 7771)

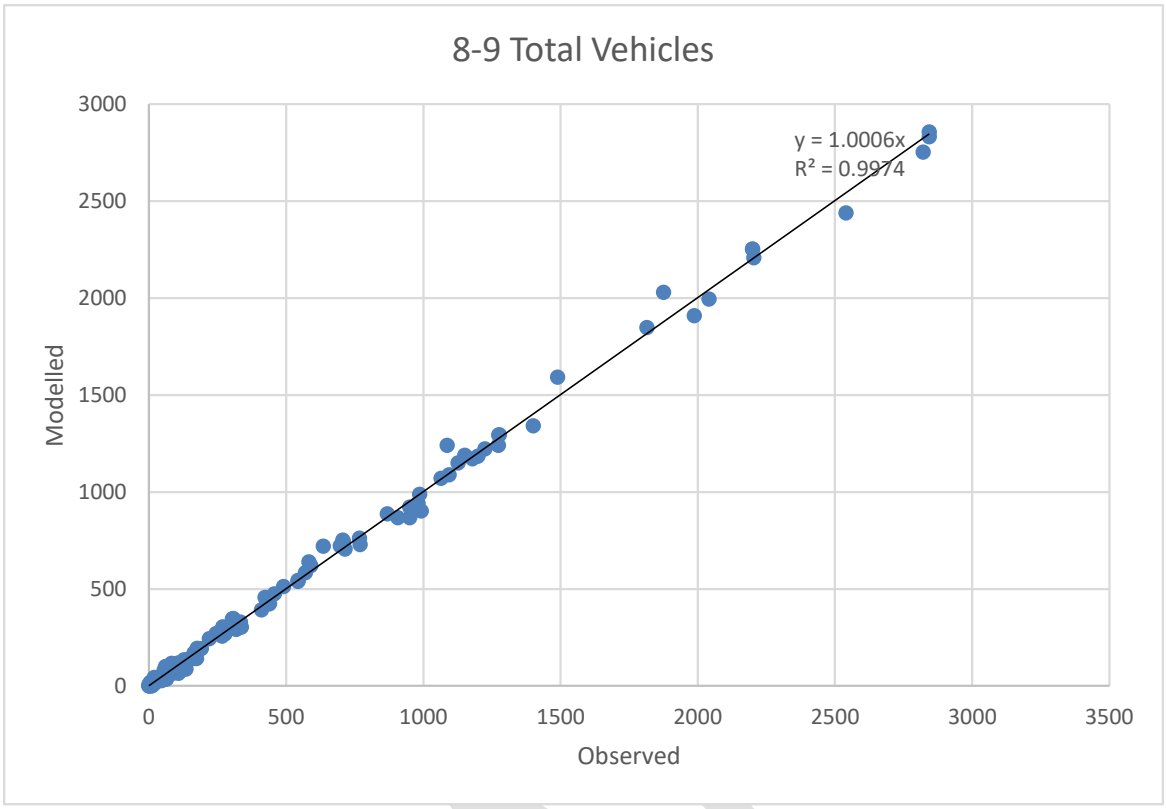

Figure 5-3 Turn Calibration 8-9 AM (median seed: 7771)

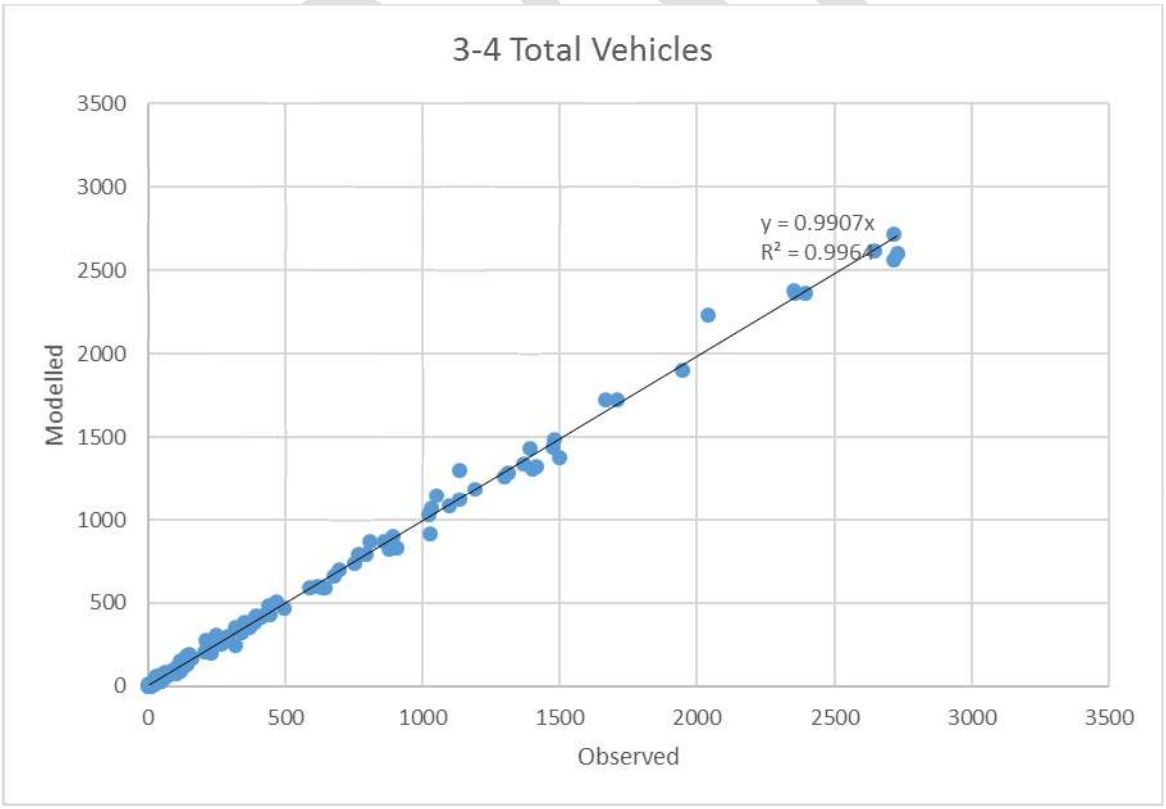

Figure 5-4 Turn Calibration 3-4 PM (median seed: 86524)

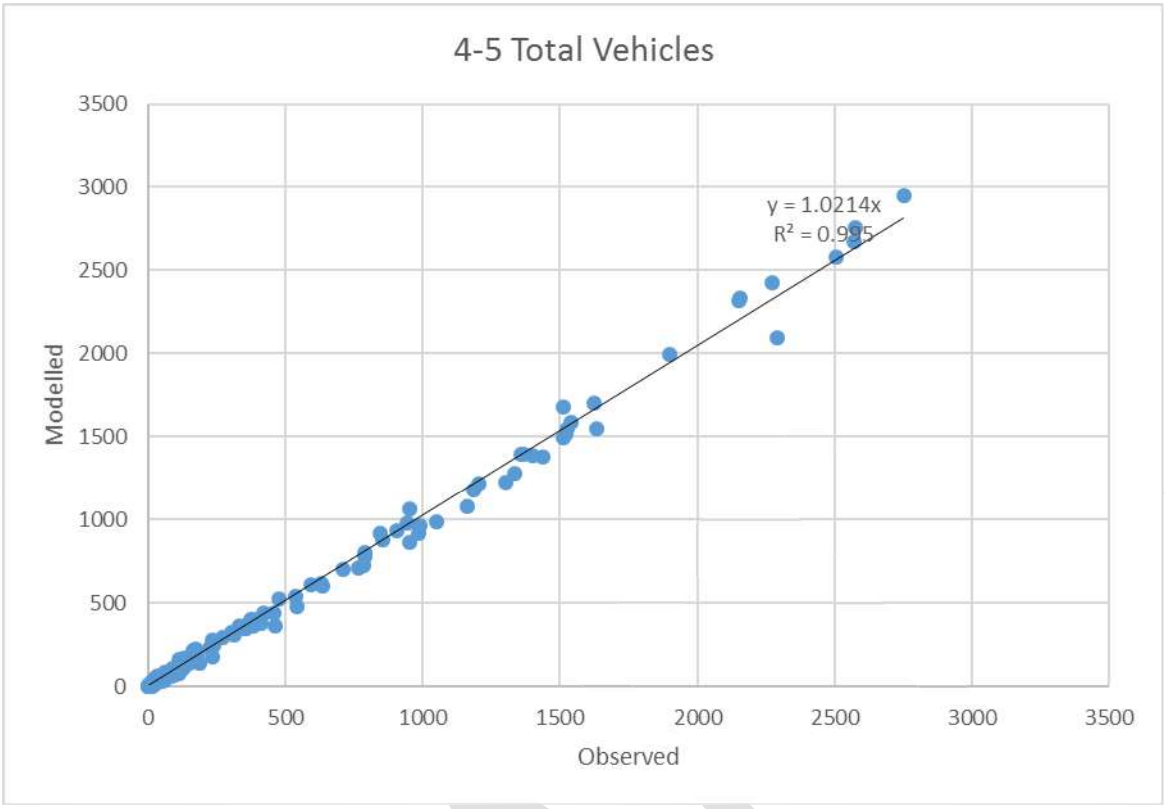

Figure 5-5 Turn Calibration 4-5 PM (median seed: 86524)

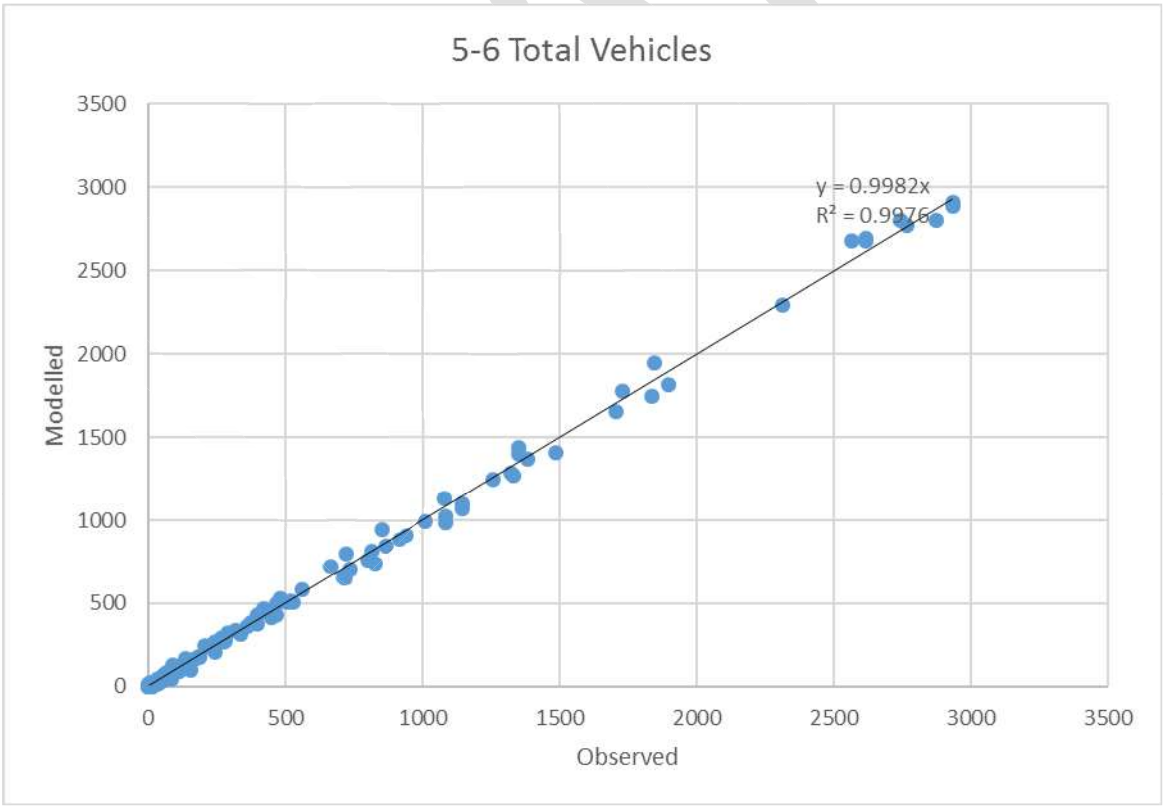

Figure 5-6 Turn Calibration 5-6 PM (median seed: 86524)

As figures 5-1 to 5-6 show, the R^2 values for all modelled periods are above 0.99, and the slope achieved also is approximately equal to one. This shows a good match between modelled turning volumes, and observed intersection counts data, indicating that a good level of calibration has been achieved.

5.1.7. Queue Calibration

Modelled queue lengths have been compared with surveyed queue lengths. The RMS Modelling Guidelines 2013 state Counting or calculating queue lengths is a subjective exercise since queued vehicles will often still be moving slowly and it will not always be clear what criteria should be used to constitute a queue. Also, since data is likely to be collected by a number of surveyors it is unlikely that consistent and accurate reporting will be possible across the study area. Additionally, software packages will each calculate queue lengths using different criteria and methodologies which add a further level of complexity. It is for this reason that the queues have been calibrated visually. The following sections show maximum queues length observed in the model.

AM Queues

John Renshaw Drive and Weakleys Drive

In the AM peak, the John Renshwaw Drive and Weakleys Drive intersection was shown to have queues up to 25 vehicles northbound, 18 vehicles southbound and 20 vehicles eastbound. These have been replicate in the model. Northbound queues are shown in Figure 5-7

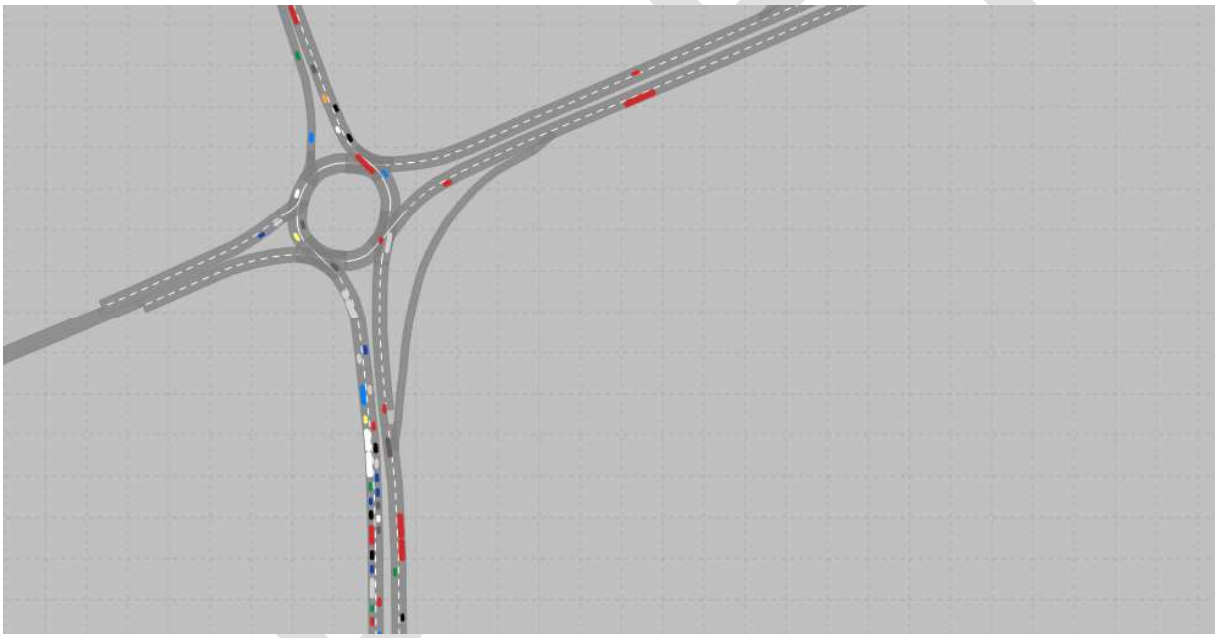

Figure 5-7 Northbound queues at John Renshaw Drive/Weakleys Drive roundabout

New England Highway and Pacific Highway

At the New England Highway and Pacific Highway intersection during the AM peak, queues were observed to be over 30 vehicles in the southbound, over 25 vehicles in the westbound and over 25 vehicles in the northbound. This is shown below in Figure 5-8

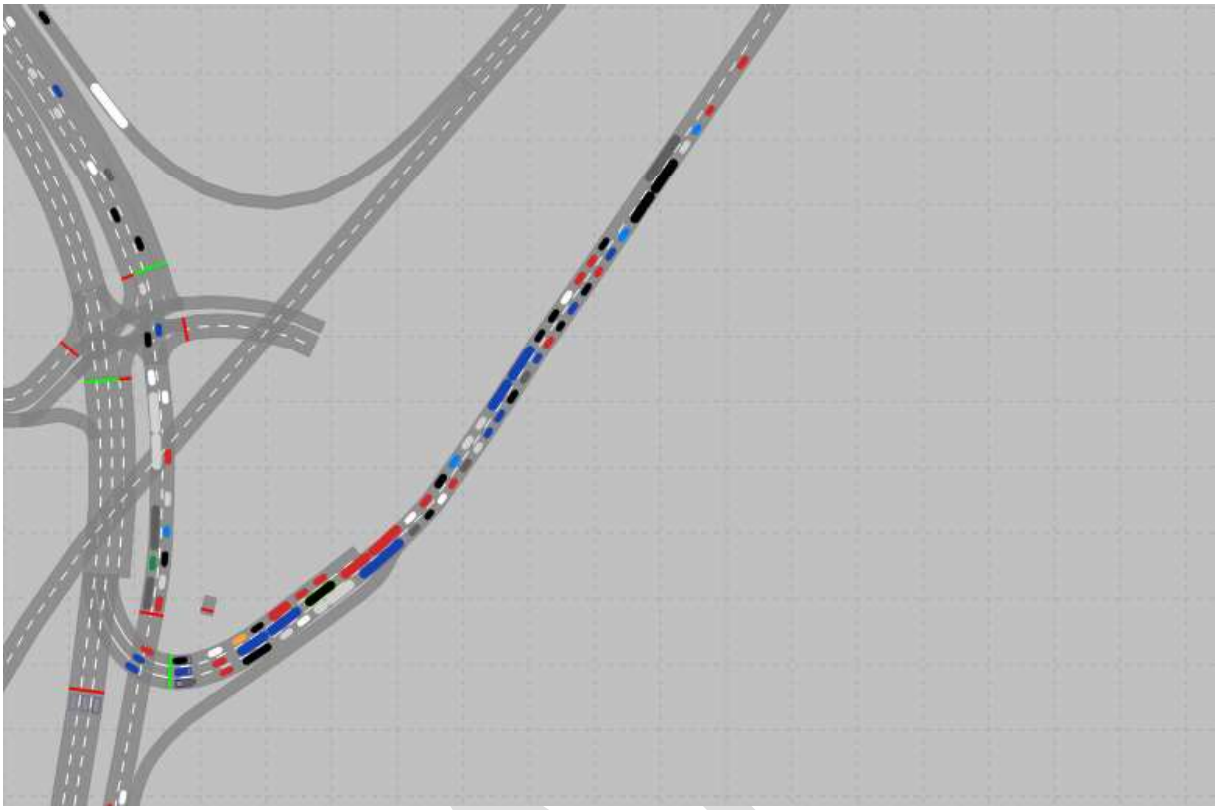

Figure 5-8 Westbound queues at New England Highway and Pacific Highway intersection

Maitland Road and Inner City bypass

At the Maitland Road and Inner City bypass intersection, the queues were measured to be over 25 vehicles northbound, over 35 vehicles eastbound and over 25 vehicles southbound. These are shown below in Figure 5-9 and Figure 5-10

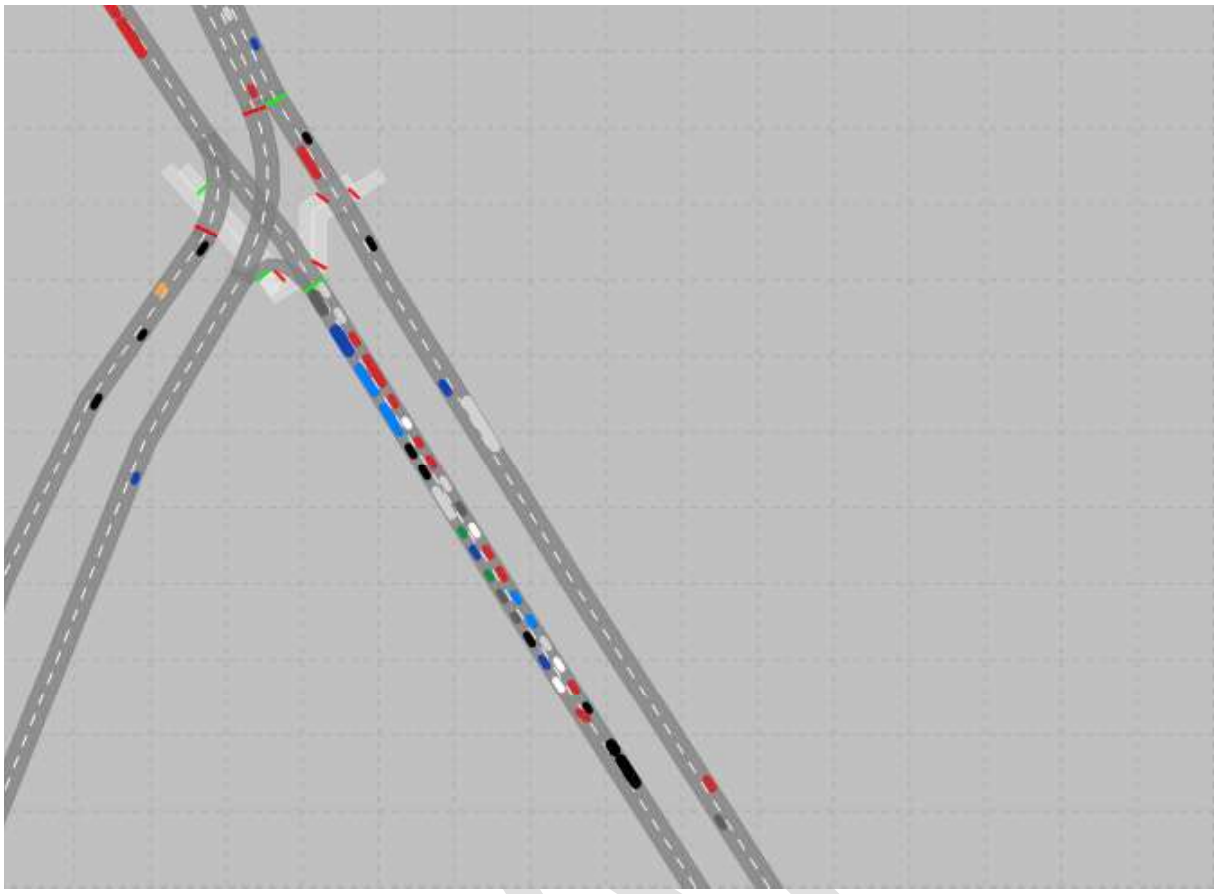

Figure 5-9 Northbound queues at Maitland Road and Inner City bypass

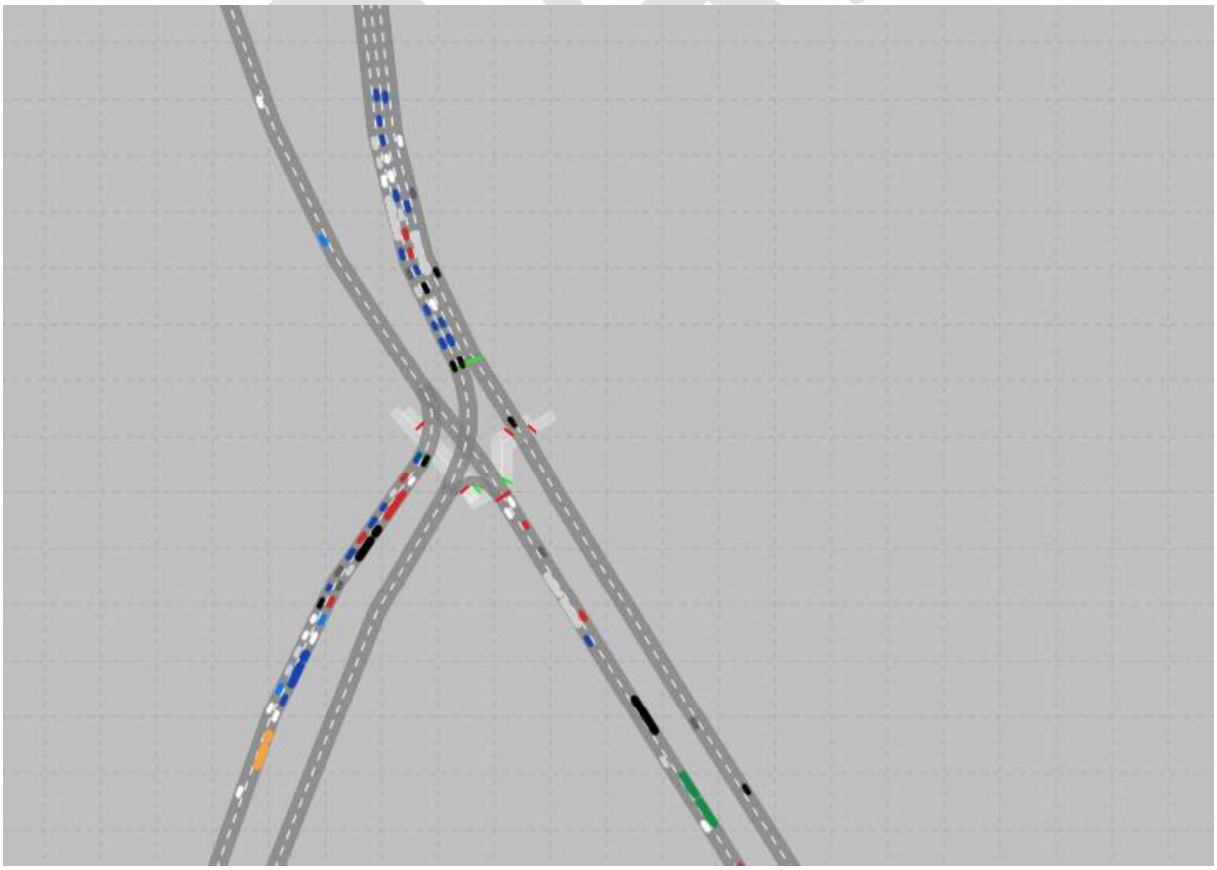

Figure 5-10 Eastbound queues at Maitland Road and Inner City bypass

PM Queues

John Renshaw Drive and Weakleys Drive

In the AM peak, the John Renshwaw Drive and Weakleys Drive intersection was shown to have queues up to 20 vehicles northbound, 19 vehicles southbound and 18 vehicles eastbound. These have been replicate in the model. Northbound queues are shown in Figure 5-11

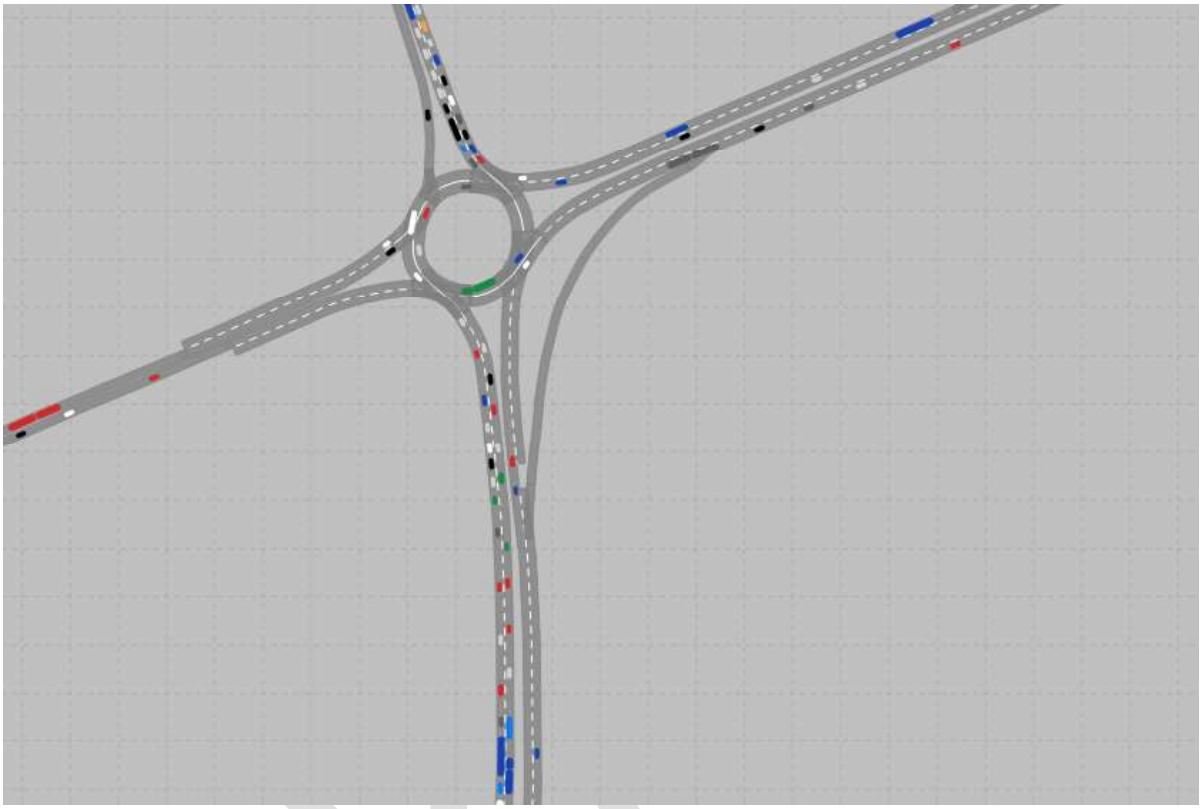

Figure 5-11 Northbound queues at John Renshaw Drive/Weakleys Drive roundabout

New England Highway and Pacific Highway

At the New England Highway and Pacific Highway intersection during the AM peak, queues were observed to be over 25 vehicles in the southbound, over 30 vehicles in the westbound and up to 35 vehicles in the northbound. This is shown below in Figure 5-12

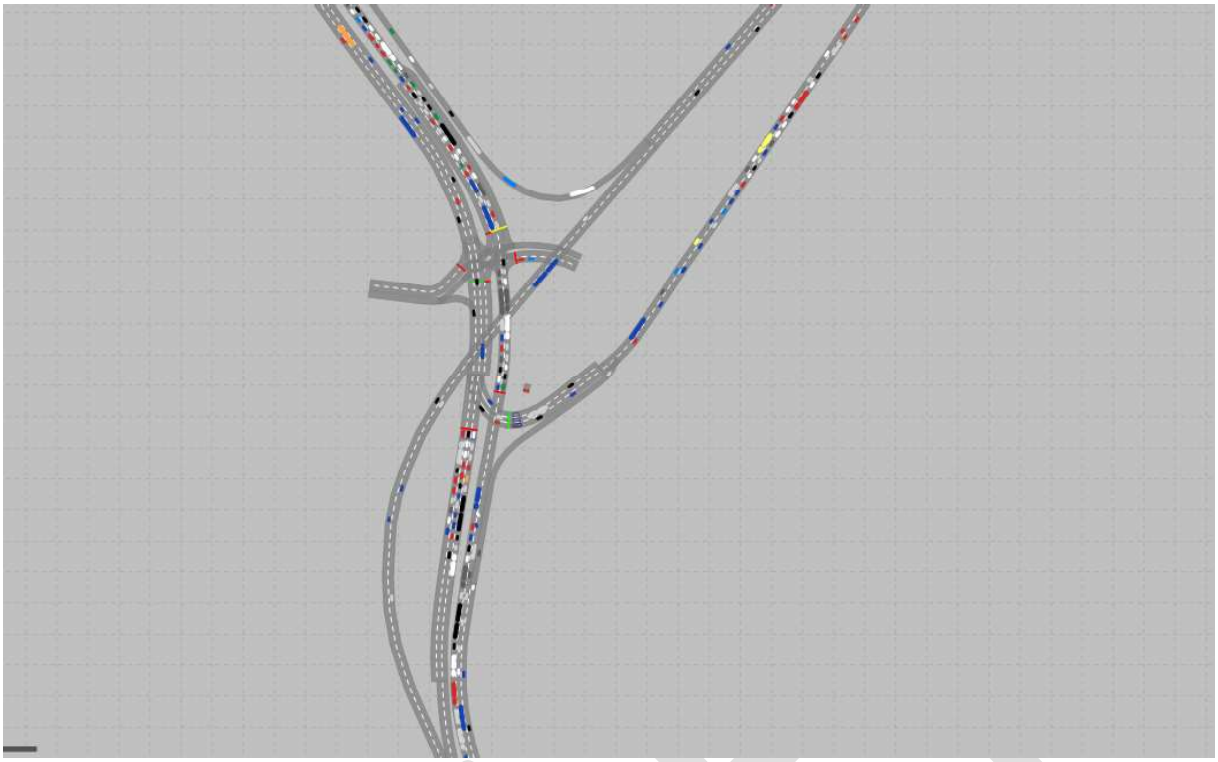

Figure 5-12 Westbound queues at New England Highway and Pacific Highway intersection

Maitland Road and Inner City bypass

At the Maitland Road and Inner City bypass intersection, the queues were measured to be over 40 vehicles northbound, over 50 vehicles eastbound and over 35 vehicles southbound. These are shown below in Figure 5-13

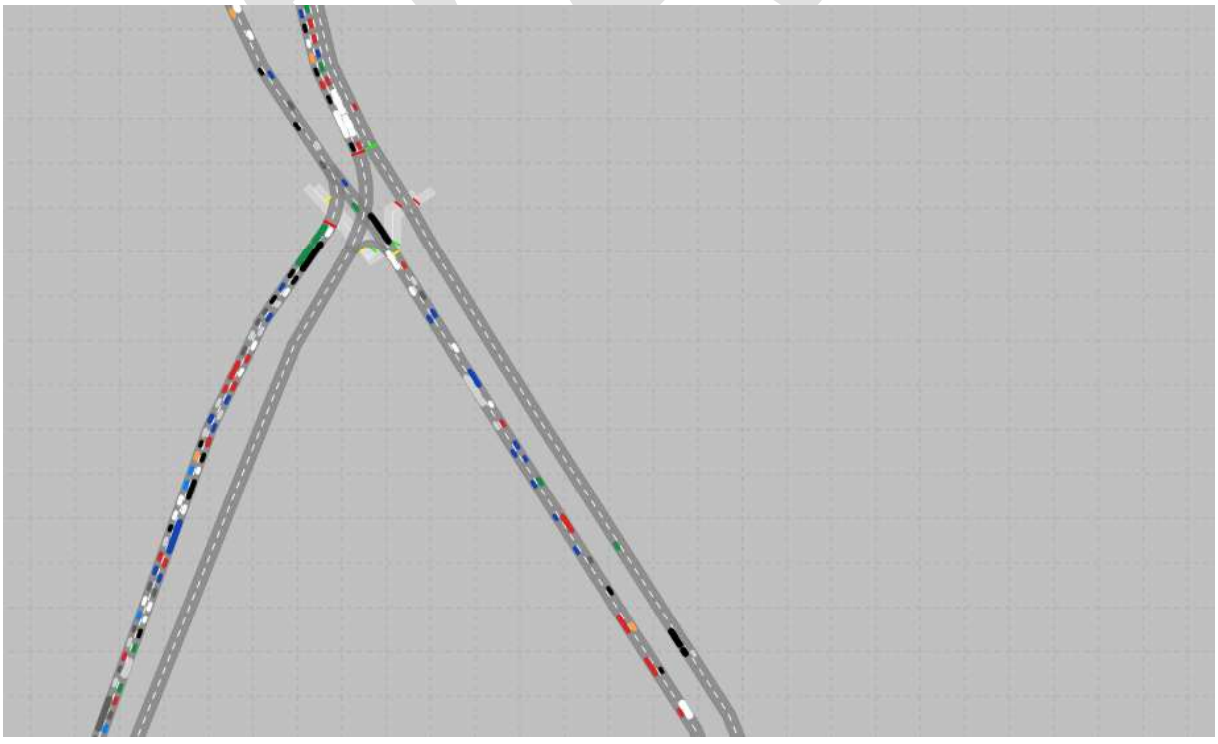

Figure 5-13 Eastbound queues at Maitland Road and Inner City bypass

5.2. Traffic Models Validation

5.2.1. Overview

Model validation is the term used to describe the independent verification process used to demonstrate that a model has been calibrated to a sufficient extent to accurately reproduce on-street conditions.

A common technique used to assess the accuracy of a model is to compare surveyed and modelled travel times along key routes in the study area. To validate the base case VISSIM models, available observed travel time data along two routes in the study area were used.

The modelling guideline recommends the following criteria for the travel time model validation:

- Average modelled journey time to be within +/-15 per cent or one minute (whichever is greater) of average observed journey time for full length of route. Each route should be cumulatively graphed by section.
- Qualitative queue length analysis has also been performed at identified key intersections

5.2.2. Travel time validation

Travel time comparison provides a good indication that the calibrated model accurately reflects delay conditions on major routes in the study area. Observed and modelled travel times, as cumulative values, were compared in the southbound and northbound direction for a travel time routes shown in Figure 5-14.

Figure 5-14 Travel time routes

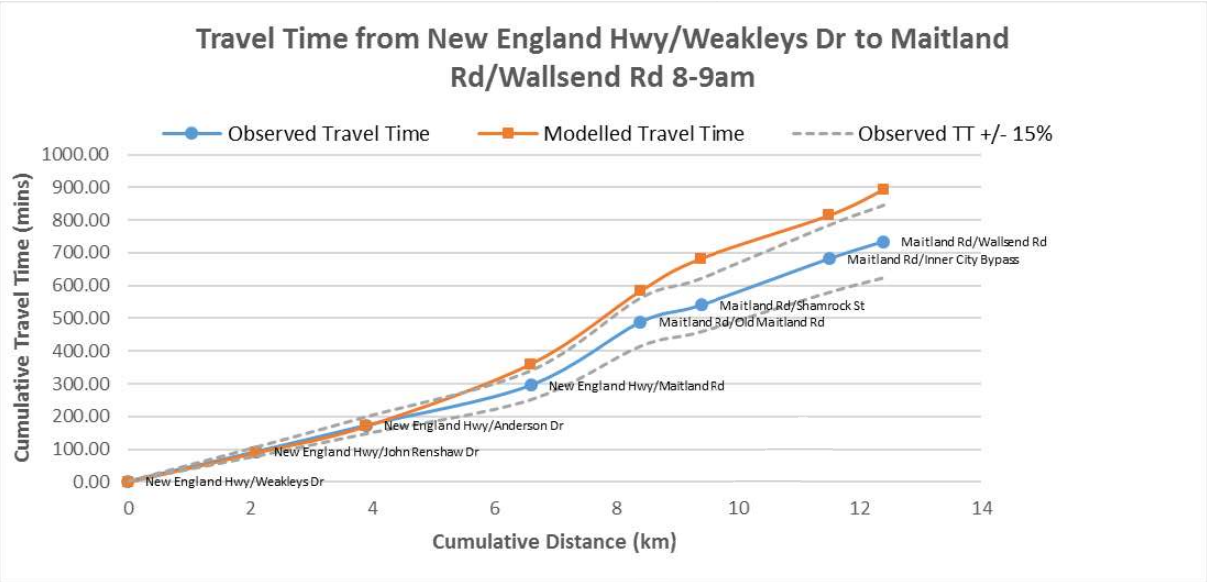

Figure 5-15 to Figure 5-26 show AM and PM peak travel time comparisons between modelled and average survey travel time data for each route and direction of travel, respectively. This comparison indicated that the most modelled travel time (orange line) is within the upper (+15 per cent) and lower (-15 per cent) boundaries of observed average travel times (Based on Google Travel time and Travel Time Surveys).

As a common modelling practice, where observed travel time show high levels of fluctuations (which indicates less stable real-time operation), proving overall traffic conditions are replicated adequately (e.g. volumes, delay, queuing conditions), it is acceptable to have some variations above the criteria in the modelled travel times.

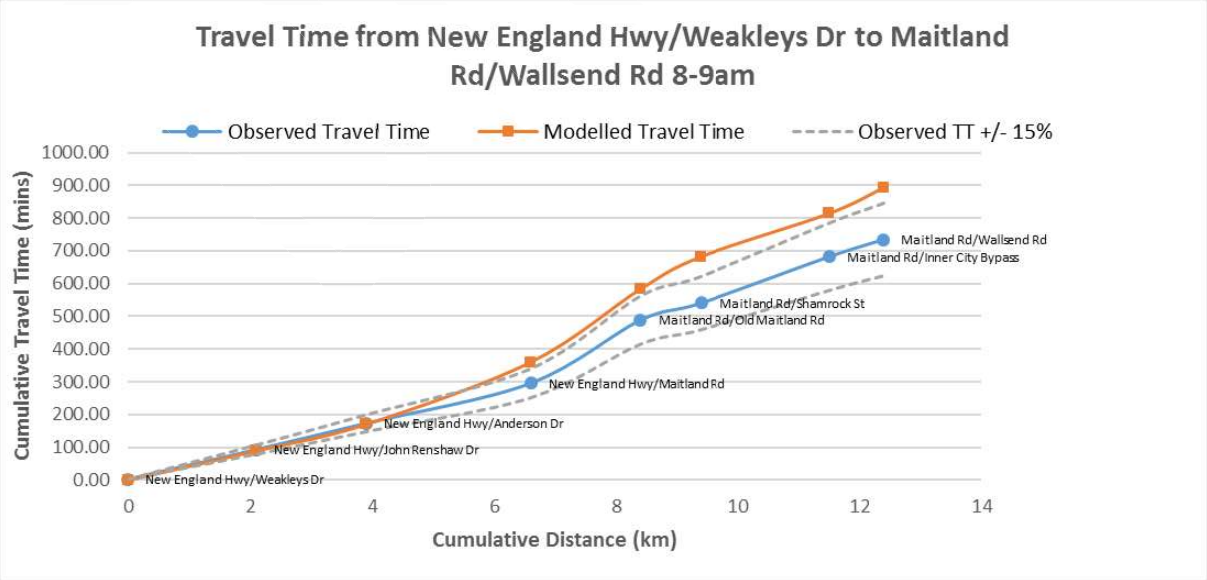

Figure 5-15 Travel time Validation Weakleys Drive to Wallsend Road 8-9 AM

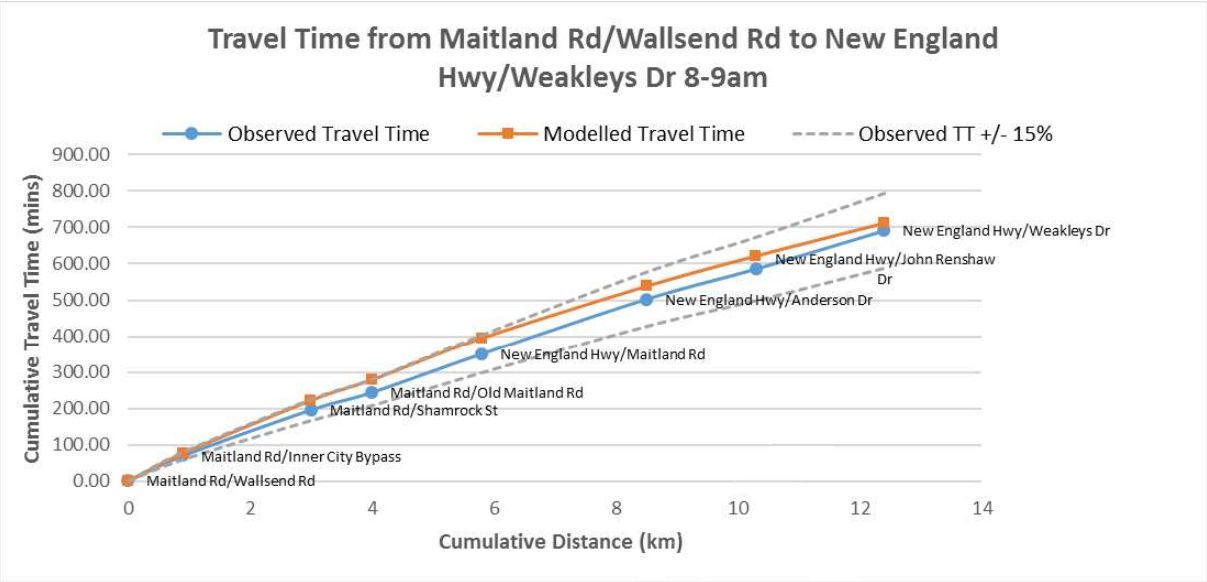

Figure 5-16 Travel time Validation Wallsend Road to Weakleys Drive 8-9 AM

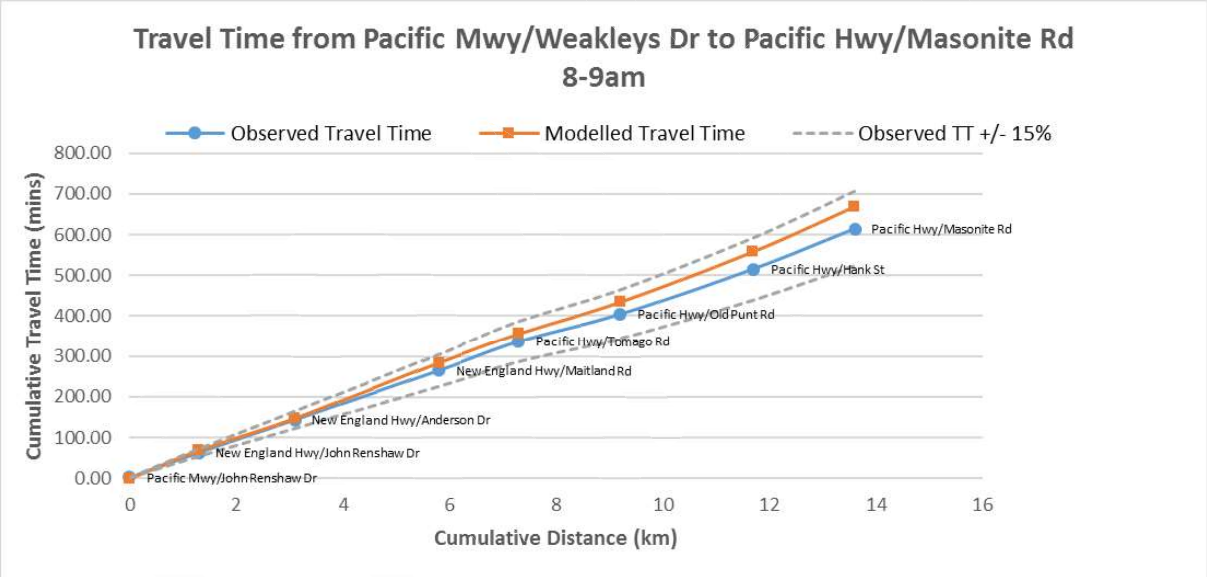

Figure 5-17 Travel time Validation Weakleys Drive to Masonite Road 8-9 AM

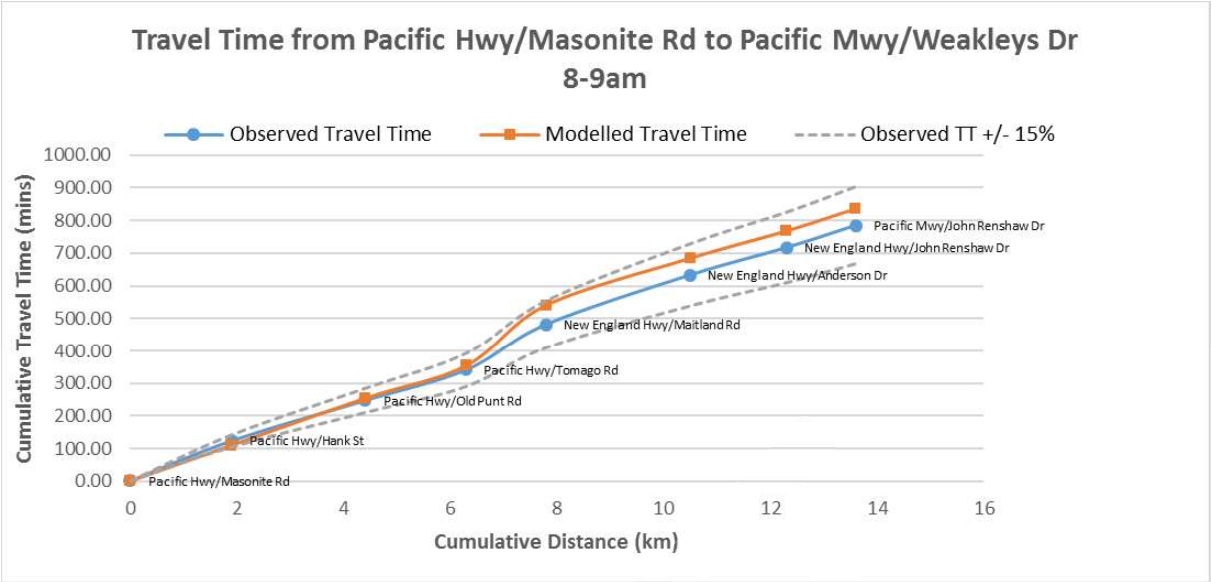

Figure 5-18 Travel time Validation Masonite Road to Weakleys Drive 8-9 AM

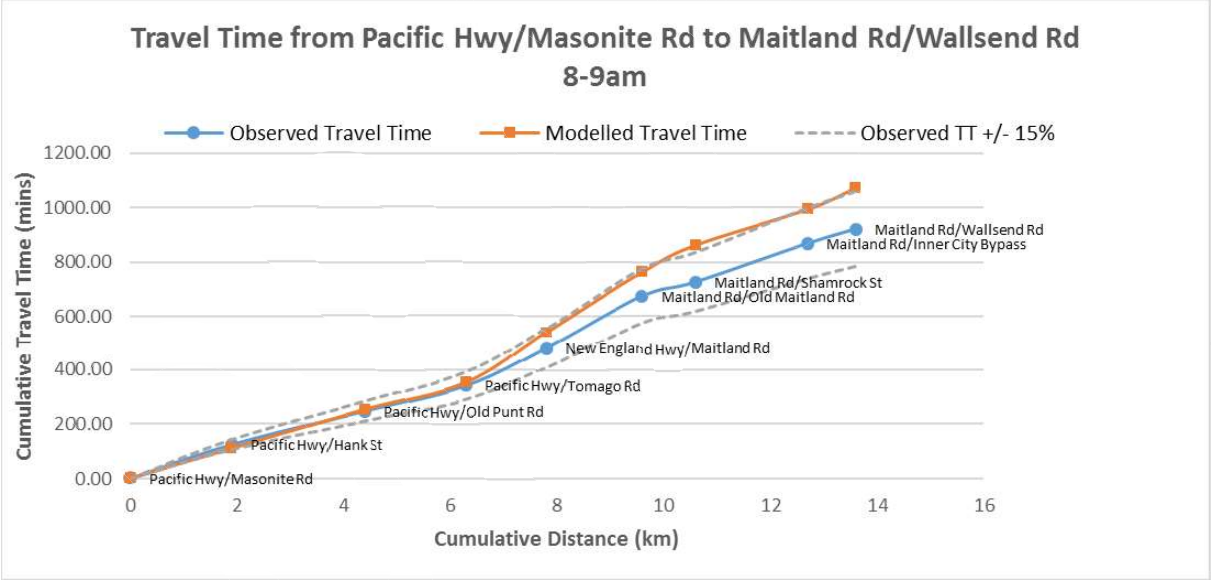

Figure 5-19 Travel time Validation Masonite Road to Wallsend Road 8-9 AM

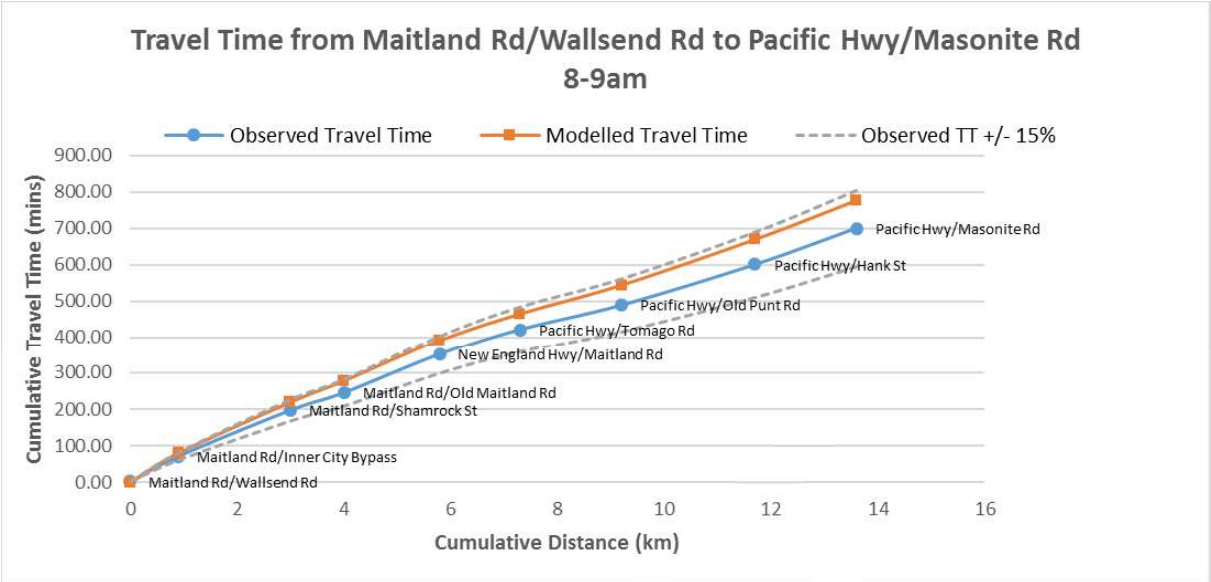

Figure 5-20 Travel time Validation Wallsend Road to Masonite Road 8-9 AM

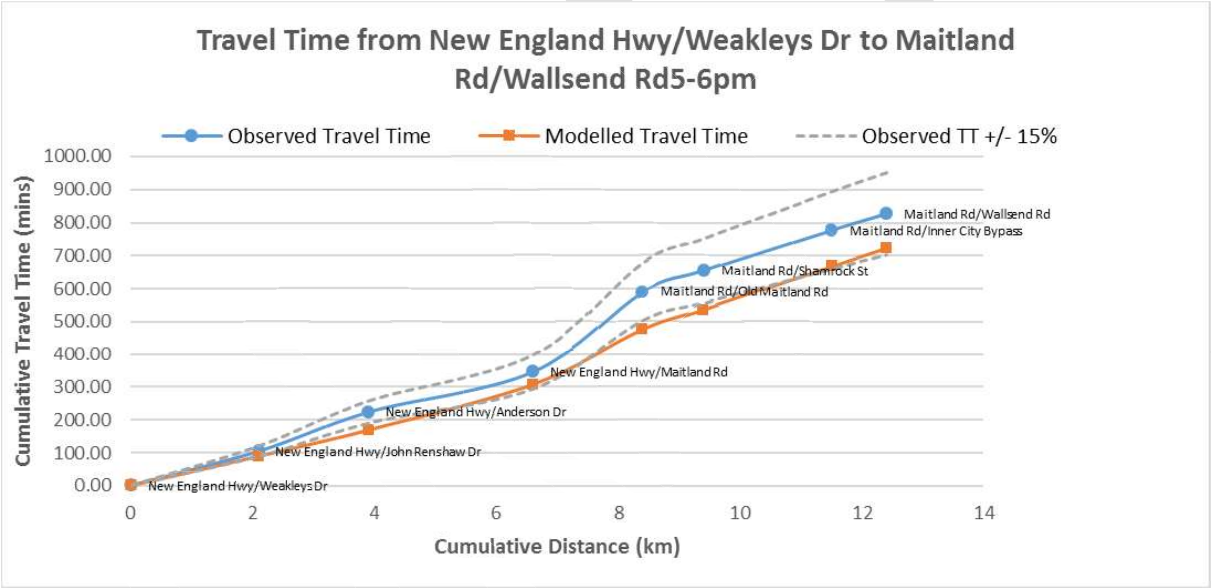

Figure 5-21 Travel time Validation Weakleys Drive to Wallsend Road 5-6 PM

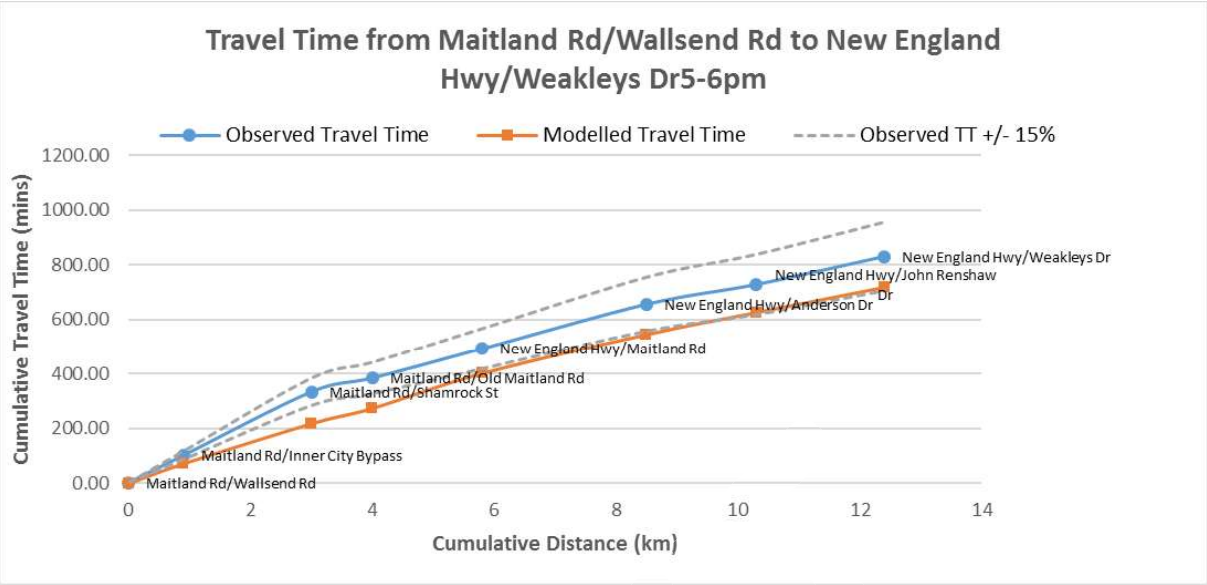

Figure 5-22 Travel time Validation Wallsend Road to Weakleys Drive 5-6 PM

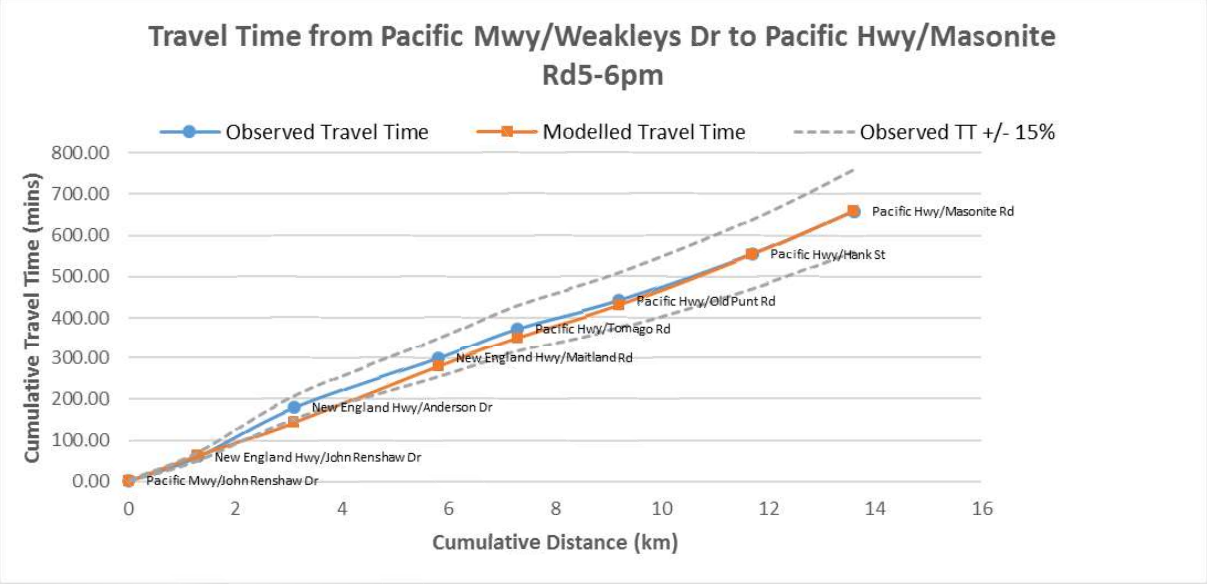

Figure 5-23 Travel time Validation Weakleys Drive to Masonite Road 5-6 PM

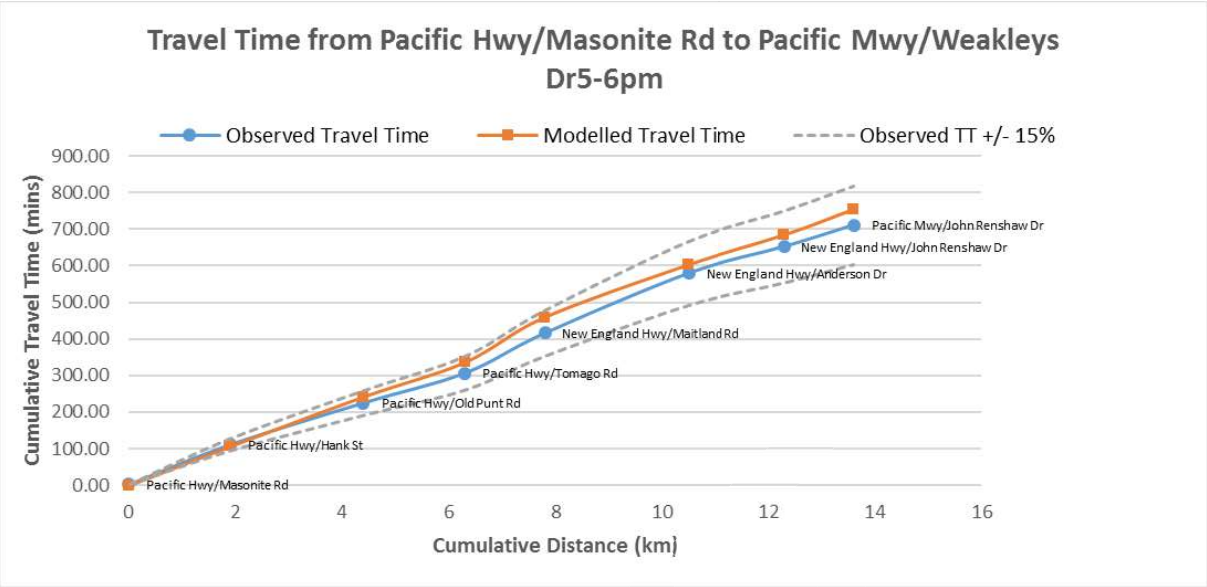

Figure 5-24 Travel time Validation Masonite Road to Weakleys Drive 5-6 PM

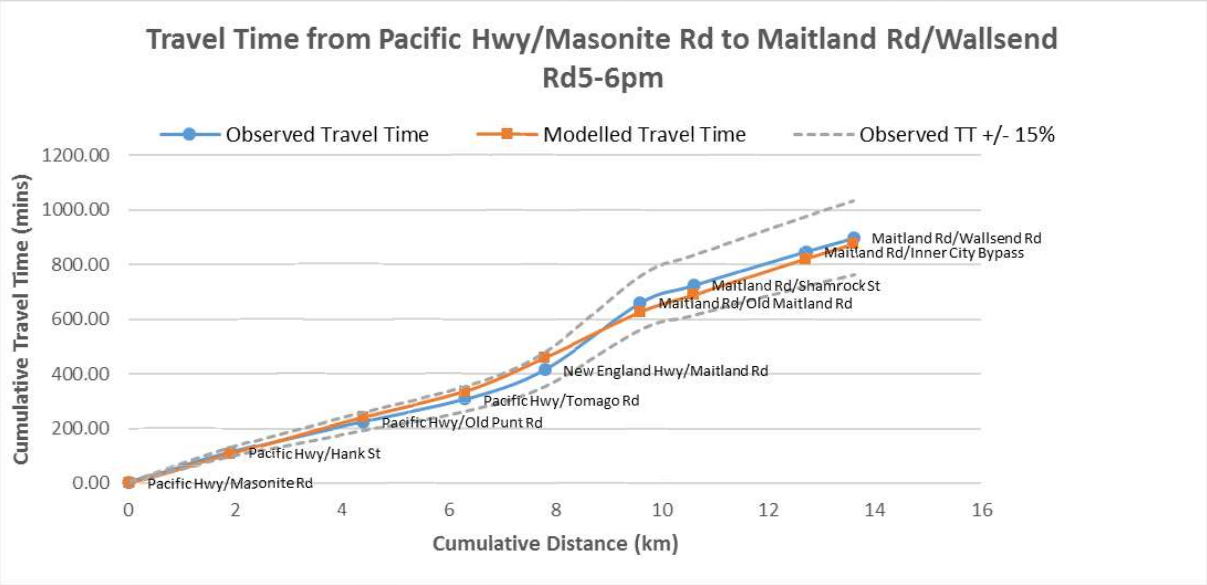

Figure 5-25 Travel time Validation Masonite Road to Wallsend Road 5-6 PM

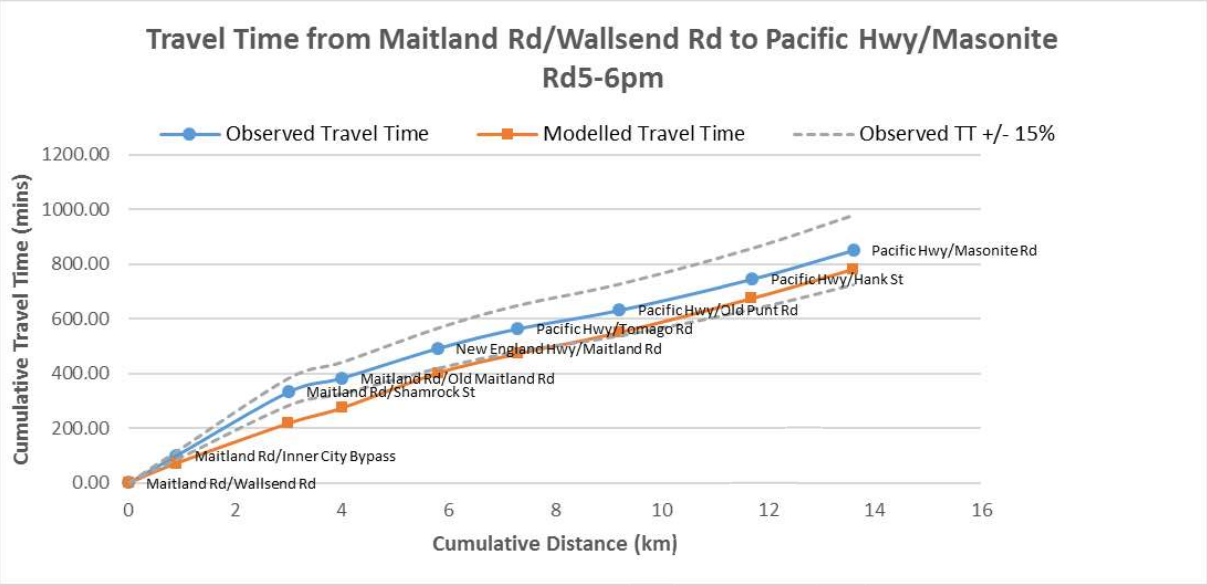

Figure 5-26 Travel time Validation Wallsend Road to Masonite Road 5-6 PM

The travel time validation graphs show the model has a good fit with the observed data. In general, due to near capacity conditions along Maitland Road between Anderson Dr and Inner City by-pass, the modelled travel time values for this section do not entirely fall within the guideline criteria , however the overall traffic conditions are adequately represented for this section in the traffic models .

In other words, since traffic models tend to show case typical (or representative travel times), it is expected to have higher levels of discrepancy between average modelled and observed travel times for less stable sections of the traffic models. In this case, the model remains a good representation of actual traffic conditions, granted that traffic congestion levels (e.g. queuing conditions) remain well represented within the model.

Graphs for all modelled hours are shown in Appendix C

6. Conclusion

The AM and PM peak base case VISSIM models were calibrated and validated as per the Roads and Maritime guidelines for average weekday conditions. The results indicate a good level of calibration with most of the model statistics close or equal to the ideal value of 100 per cent.

The model validation indicated that the modelled travel time is generally within the upper (+15 per cent) and lower (-15 per cent) boundary of observed average travel time values and followed the similar trend with the average survey travel time data.

It can be concluded that the comparison between modelled and observed travel times satisfies Roads and Maritime's travel time validation criteria in AM and PM Peak periods.

In summary, it is concluded that the base year traffic models are "fit for purpose "for the Outer Newcastle Study (ONS), which will inform the strategic design, economic analysis and prioritisation of future state road upgrades in the study area.

Attachment B. Detailed modelling results

Attachment B – Detailed modelling outputs

B1. Travel time

Table B1: Morning peak travel time results 6–7 AM

Direction	Segment	Distance (km)	Morning Peak (6-7 AM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:36	01:38	01:45	02:24	02:33	02:40	50%	56%	52%
	Segment 2	1.69	01:40	01:38	01:40	01:35	01:33	01:35	-5%	-5%	-5%
	Segment 3	2.43	02:30	02:54	05:34	01:33	01:33	01:34	-38%	-47%	-72%
	Full Route	5.91	05:46	06:10	08:59	05:32	05:39	05:49	-4%	-8%	-35%
Northbound	Segment 1	1.80	02:10	02:28	04:25	01:57	01:56	01:59	-10%	-22%	-55%
	Segment 2	1.70	01:44	01:48	02:12	01:40	01:39	01:49	-4%	-8%	-17%
	Segment 3	2.42	02:15	02:16	02:19	02:16	02:17	02:24	1%	1%	4%
	Full Route	5.92	06:08	06:32	08:56	05:55	05:52	06:08	-4%	-10%	-31%

Table B2: Morning peak travel time results 7–8 AM

Direction	Segment	Distance (km)	Morning Peak (7-8 AM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:37	01:44	01:42	02:38	03:16	03:41	63%	88%	117%
	Segment 2	1.69	01:47	01:41	01:38	01:40	01:46	01:46	-7%	5%	8%
	Segment 3	2.43	06:17	07:17	10:13	01:51	03:07	03:29	-71%	-57%	-66%
	Full Route	5.91	09:41	10:42	13:33	06:09	08:00	08:46	-36%	-25%	-35%
Northbound	Segment 1	1.80	02:25	04:23	04:53	02:02	02:22	02:25	-16%	-46%	-51%
	Segment 2	1.70	01:56	02:07	02:11	01:40	01:40	01:48	-14%	-21%	-18%
	Segment 3	2.42	02:15	02:15	02:24	02:21	02:23	02:40	4%	6%	11%
	Full Route	5.92	06:36	08:45	09:29	06:01	06:20	06:51	-9%	-28%	-28%

Table B3: Morning peak travel time results 8–9 AM

Direction	Segment	Distance (km)	Morning Peak (8-9AM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:37	01:43	01:39	02:30	03:44	04:55	55%	117%	198%
	Segment 2	1.69	02:19	02:12	02:11	01:38	04:32	04:24	-29%	106%	102%
	Segment 3	2.43	09:45	10:08	10:38	01:55	05:40	05:36	-80%	-44%	-47%
	Full Route	5.91	13:41	14:03	14:28	06:08	13:55	14:30	-55%	-1%	0%
Northbound	Segment 1	1.80	02:23	05:19	06:06	02:05	02:06	02:17	-13%	-61%	-63%
	Segment 2	1.70	01:54	02:29	02:26	01:42	01:38	01:46	-11%	-34%	-27%
	Segment 3	2.42	02:16	02:18	02:18	02:17	02:19	02:24	1%	1%	4%
	Full Route	5.92	06:34	10:06	10:50	06:03	06:05	06:23	-8%	-40%	-41%

Table B4: Evening peak travel time results 3–4 PM

Direction	Segment	Distance (km)	Evening peak (3-4 PM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:57	01:52	01:51	02:40	02:50	03:09	37%	52%	70%
	Segment 2	1.69	01:50	01:55	01:44	01:36	01:36	01:38	-13%	-17%	-6%
	Segment 3	2.43	02:50	05:29	07:16	01:33	01:34	01:35	-45%	-71%	-78%
	Full Route	5.91	06:37	09:16	10:51	05:48	05:58	06:18	-12%	-36%	-42%
Northbound	Segment 1	1.80	03:38	04:01	04:38	01:57	02:12	02:27	-46%	-45%	-47%
	Segment 2	1.70	02:02	02:03	02:06	01:42	01:46	01:49	-16%	-14%	-13%
	Segment 3	2.42	02:24	02:27	02:33	02:24	02:28	02:31	0%	1%	-1%
	Full Route	5.92	08:05	08:31	09:16	06:01	06:27	06:43	-26%	-24%	-28%

Table B5: Evening peak travel time results 4–5 PM

Direction	Segment	Distance (km)	Evening peak (4-5 PM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:43	01:51	01:43	02:41	02:45	03:05	56%	49%	80%
	Segment 2	1.69	01:49	01:52	01:40	01:35	01:36	01:39	-13%	-14%	-1%
	Segment 3	2.43	02:52	11:12	12:10	01:33	01:33	01:36	-46%	-86%	-87%
	Full Route	5.91	06:24	14:56	15:33	05:50	05:56	06:26	-9%	-60%	-59%
Northbound	Segment 1	1.80	04:18	04:26	04:34	02:06	02:23	02:22	-51%	-46%	-48%
	Segment 2	1.70	01:56	01:59	02:13	01:40	01:45	02:05	-14%	-12%	-6%
	Segment 3	2.42	02:24	02:25	02:34	02:21	02:28	06:29	-2%	2%	153%
	Full Route	5.92	08:38	08:50	09:22	06:08	06:35	10:44	-29%	-25%	15%

Table B6: Evening peak travel time results 5–6 PM

Direction	Segment	Distance (km)	Evening peak (5-6 PM)						Diff (%)		
			2028 DoMin	2038 DoMin	2048 DoMin	2028 (With proposal)	2038 (With proposal)	2048 (With proposal)	2028	2038	2048
Southbound	Segment 1	1.79	01:43	01:40	01:48	02:48	02:59	03:13	63%	79%	79%
	Segment 2	1.69	01:53	01:56	01:43	01:38	01:38	01:38	-13%	-16%	-5%
	Segment 3	2.43	04:28	11:52	12:48	01:37	01:36	01:41	-64%	-87%	-87%
	Full Route	5.91	10:52	15:29	16:19	06:04	06:13	06:34	-44%	-60%	-60%
Northbound	Segment 1	1.80	04:28	04:32	05:09	02:03	02:23	03:24	-54%	-47%	-34%
	Segment 2	1.70	02:14	02:07	02:09	01:41	01:44	02:44	-25%	-18%	27%
	Segment 3	2.42	02:22	02:22	02:28	02:35	02:42	04:31	9%	14%	83%
	Full Route	5.92	09:04	09:01	09:46	06:20	06:46	10:22	-30%	-25%	6%

B2. Intersection Performance

Table B7: Morning peak intersection delays and level of service in 2028

Intersection	Type	6-7 AM				7-8 AM				8-9 AM			
		2028 DoMin		2028 (With proposal)		2028 DoMin		2028 (With proposal)		2028 DoMin		2028 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	4	A	17	B	34	C	20	B	60	E	18	B
Maitland Road/ Old Maitland Road (North)	Signalised	3	A	3	A	28	C	4	A	45	D	5	A
Maitland Road/ Old Maitland Road (South)	Signalised	7	A	4	A	8	A	6	A	11	B	5	A
Maitland Road/ Shamrock Street	Signalised	11	B	8	A	18	B	10	A	22	C	11	B
Maitland Road/ Sparke Street	Signalised	8	A	5	A	9	A	6	A	9	A	7	A
Maitland Road/ Newcastle Inner City Bypass	Signalised	21	C	20	B	24	C	21	C	24	C	23	C

Table B8: Evening peak intersection delays and level of service in 2028

Intersection	Type	3-4 PM				4-5 PM				5-6 PM			
		2028 DoMin		2028 (With proposal)		2028 DoMin		2028 (With proposal)		2028 DoMin		2028 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	8	A	21	C	8	A	19	B	40	D	22	C
Maitland Road/ Old Maitland Road (North)	Signalised	10	A	6	A	9	A	7	A	34	C	9	A
Maitland Road/ Old Maitland Road (South)	Signalised	6	A	5	A	8	A	6	A	11	B	8	A
Maitland Road/ Shamrock Street	Signalised	18	B	11	B	17	B	9	A	22	C	11	B
Maitland Road/ Sparke Street	Signalised	20	B	6	A	19	B	7	A	21	C	7	A
Maitland Road/ Newcastle Inner City Bypass	Signalised	51	D	27	C	57	E	27	C	62	E	27	C

Table B9: Morning peak intersection delays and level of service in 2038

Intersection	Type	6-7 AM				7-8 AM				8-9 AM			
		2038 DoMin		2038 (With proposal)		2038 DoMin		2038 (With proposal)		2038 DoMin		2038 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	5	A	18	B	44	D	26	C	63	E	23	C
Maitland Road/ Old Maitland Road (North)	Signalised	4	A	4	A	32	C	5	A	44	D	5	A
Maitland Road/ Old Maitland Road (South)	Signalised	8	A	5	A	9	A	8	A	10	A	16	B
Maitland Road/ Shamrock Street	Signalised	11	B	7	A	18	B	10	A	27	C	38	D
Maitland Road/ Sparke Street	Signalised	9	A	6	A	19	B	13	B	26	C	46	D
Maitland Road/ Newcastle Inner City Bypass	Signalised	27	C	18	B	50	D	32	C	54	D	39	D

Table B10: Evening peak intersection delays and level of service in 2038

Intersection	Type	3-4 PM				4-5 PM				5-6 PM			
		2038 DoMin		2038 (With proposal)		2038 DoMin		2038 (With proposal)		2038 DoMin		2038 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	32	C	23	C	78	E	22	C	79	E	23	C
Maitland Road/ Old Maitland Road (North)	Signalised	10	A	9	A	45	D	9	A	46	D	8	A
Maitland Road/ Old Maitland Road (South)	Signalised	6	A	5	A	12	B	6	A	17	B	8	A
Maitland Road/ Shamrock Street	Signalised	18	B	11	B	19	B	11	B	22	C	11	B
Maitland Road/ Sparke Street	Signalised	20	B	8	A	20	B	10	A	20	C	10	B
Maitland Road/ Newcastle Inner City Bypass	Signalised	51	D	28	C	74	E	28	C	72	E	25	C

Table B11: Morning peak intersection delays and level of service in 2048

Intersection	Type	6-7 AM				7-8 AM				8-9 AM			
		2048 DoMin		2048 (With proposal)		2048 DoMin		2048 (With proposal)		2048 DoMin		2048 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	32	C	22	C	66	E	32	C	72	E	30	C
Maitland Road/ Old Maitland Road (North)	Signalised	28	C	5	A	43	D	8	A	44	D	10	A
Maitland Road/ Old Maitland Road (South)	Signalised	8	A	6	A	9	A	8	A	10	A	17	B
Maitland Road/ Shamrock Street	Signalised	17	B	12	B	17	B	12	B	28	C	39	D
Maitland Road/ Sparke Street	Signalised	22	C	7	A	21	C	12	B	29	C	42	D
Maitland Road/ Newcastle Inner City Bypass	Signalised	53	D	15	B	68	E	35	D	72	E	40	D

Table B12: Evening peak intersection delays and level of service in 2048

Intersection	Type	3-4 PM				4-5 PM				5-6 PM			
		2048 DoMin		2048 (With proposal)		2048 DoMin		2048 (With proposal)		2048 DoMin		2048 (With proposal)	
		Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS	Average Delays (S)	LoS
New England Highway/Maitland Road/Pacific Highway	Signalised	49	D	30	C	76	E	50	D	78	E	33	C
Maitland Road/ Old Maitland Road (North)	Signalised	35	D	9	A	48	D	23	C	48	D	15	B
Maitland Road/ Old Maitland Road (South)	Signalised	10	A	5	A	13	B	11	B	14	B	16	B
Maitland Road/ Shamrock Street	Signalised	18	B	13	B	19	B	13	B	19	B	20	B
Maitland Road/ Sparke Street	Signalised	21	C	9	A	20	C	10	B	22	C	20	B
Maitland Road/ Newcastle Inner City Bypass	Signalised	54	D	32	C	49	D	29	C	58	E	32	C