



Transport
for NSW

Newcastle Light Rail

Review of Environmental Factors



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Appendices

Appendix A Strategic review and planning context for the proposal

Appendix B Consideration of clause 228 factors and ESD

Technical papers

The following technical papers informed the preparation of the REF. These papers are available on the Transport for NSW website at <http://www.transport.nsw.gov.au/projects>.

Technical Paper 1 – Traffic, transport and access assessment

Technical Paper 2 – Noise and vibration assessment

Technical Paper 3 – Statement of heritage impact

Technical Paper 4 – Aboriginal heritage due diligence assessment

Technical Paper 5 – Urban landscape and visual assessment

Technical Paper 6 – Socio-economic assessment

Abbreviations

Abbreviation	Definition
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
CBD	central business district
CCTV	closed circuit television
CEMP	construction environmental management plan
CPTED	crime prevention through environmental design
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
the Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
GHD	GHD Pty Ltd
Infrastructure SEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>
ISCA	Infrastructure Sustainability Council of Australia
the LEP	<i>Newcastle Local Environmental Plan 2012</i>
LGA	local government area
LALC	Local Aboriginal Land Council
NCA	noise catchment area
NEPM	National Environment Protection Measure
NUTTP	Newcastle Urban Transformation and Transport Program
OEH	NSW Office of Environment and Heritage
PB	Parsons Brinckerhoff
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
RBL	Rating background level (noise)
REF	review of environmental factors
RING	<i>Rail Infrastructure Noise Guideline (EPA, 2013)</i>
RMS	Roads and Maritime Services
SCADA	supervisory, control and data acquisition
SEPP	state environmental planning policy
TfNSW	Transport for NSW
TSC Act	<i>Threatened Species Conservation Act 1995</i>

Definitions

Term	Definition
archaeological potential	The site's potential to contain archaeological relics
ballast	Crushed rock, stone etc used to provide a foundation for a road or railway track. It usually provides the bed on which railway sleepers are laid
catenary system	Electric power system for a rail vehicle which uses an overhead contact wire, and its supporting cables and wires
ecologically sustainable development	Development that uses, conserves and enhances the resources of the community so that ecological processes on which life depends are maintained, and the total quality of life, now and in the future, can be increased
emission	A substance discharged into the air
heritage listed	An item, building or place included on statutory heritage lists maintained by local, State or the Australian Government
LAE	The 'sound exposure level', which is used to indicate the total acoustic energy of an individual noise event. This parameter is used in the calculation of LAeq values from individual noise events.
LAeq(24 hour)	The 'equivalent continuous noise level', sometimes also described as the 'energy-averaged noise level' LAeq(24hour) may be likened to a 'noise dose', representing the cumulative effects of all the proposal noise events occurring in one day
LAeq(15 hour)	The daytime 'equivalent continuous noise level' the LAeq(15hour) represents the cumulative effects of all the proposal noise events occurring in the daytime period from 7.00am to 10.00pm
LAeq(9 hour)	The night-time 'equivalent continuous noise level', the LAeq(9hour) represents the cumulative effects of all the proposal noise events occurring in the night-time period from 10.00pm to 7.00am
LAeq(1 hour)	The busiest 1-hour 'equivalent continuous noise level', the LAeq(1hour) represents the typical LAeq noise level from all the proposal noise events during the busiest 1-hour of the assessment period
level crossing	A place where rail lines and a road cross at the same elevation
level of service	Defined by Austroads as a measure for ranking operating road and intersection conditions, based on factors such as speed, travel time, freedom to manoeuvre, interruptions, comfort and convenience
light rail alignment	The location of the light rail tracks along which the light rail vehicles would operate
local road	Road used primarily to access properties located along the road
mixed running	The light rail alignment is located within the road corridor in a lane which is also used by general road traffic
the proposal	The construction and operation of the Newcastle Light Rail project
proposal site	The construction footprint, including the area that would be directly affected by construction works
rating background level	The underlying level of noise present in an area once transient and short-term noise events are filtered out
relic	A relic is defined by the NSW <i>Heritage Act 1977</i> as 'any artefact, object or material evidence which relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and which is of State or local heritage significance.'
sensitive receivers	Land uses which are sensitive to potential noise, air and visual impacts, such as residential dwellings, schools and hospitals

Term	Definition
segregated running	The light rail alignment is located in its own corridor, which is separate from the road corridor
separated running	The light rail alignment is located within the road corridor in a dedicated lane which is not generally used (except for crossing purposes) by general road traffic
stabling	The act of taking a light rail vehicle out of service and parking it in a siding or stabling facility, usually overnight or longer
study area	The area including and adjacent to the proposal site, with the potential to be impacted by activities on the proposal site
submissions report	Used to summarise the issues raised by submissions received in response to public display of the REF, and to provide TfNSW's responses to the issues raised
substation (traction)	A traction substation is an electrical substation that converts electric power from the form provided by the electricity provider to an appropriate voltage, current type and frequency which can be used to supply the light rail network with power
the former rail corridor	The heavy rail corridor between Wickham Transport Interchange and Newcastle Station – no longer used for heavy rail services
traction power	Power required to operate light rail vehicles on the rail network
turnout	A junction point where a light rail vehicle could change between two routes/travel directions

Executive summary

Overview

Transport for NSW (TfNSW) has completed a Review of Environmental Factors (REF) to consider the potential benefits and impacts of the construction and operation of the Newcastle Light Rail Project (the proposal). The REF has been prepared in accordance with the provisions of Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and will be used to assist TfNSW determine whether to proceed with the proposal. Feedback from the community and other key stakeholders received during the public display of the REF will also be considered when making this determination.

The strategic context for the proposal

Newcastle is the second biggest city in NSW and, by 2036, its city centre is expected to accommodate an additional 10,000 jobs and 6,000 homes (NSW Planning and Environment, 2014).

In 2012, the NSW Government released the *Newcastle Urban Renewal Strategy*, a 25 year plan to revitalise Newcastle, reinforce its role as a 21st century regional centre, and provide a framework to create the jobs and homes needed by 2036. The *Newcastle Urban Renewal Strategy* identifies transport, access and connectivity as a guiding principle for the urban renewal of Newcastle.

The Newcastle Urban Transformation and Transport Program (the NUTTP) is part of UrbanGrowth NSW's portfolio of projects set to help deliver the *Newcastle Urban Renewal Strategy*. The NUTTP is underpinned by the following objectives that have been developed in consultation with the community:

- Bring people back to the city centre.
- Reconnect the city to its waterfront.
- Help grow new jobs in the city centre.
- Create great places linked to new transport.
- Create economically sustainable public domain and community assets.
- Preserve and enhance the city centre's heritage and culture.

The NUTTP aims to strengthen connections between the city and the waterfront, create employment opportunities, provide more public space and amenity and deliver better transport solutions.

The NSW Government has made a number of announcements related to the transformation of Newcastle, including:

- a new multi-modal transport interchange at Wickham
- light rail between Wickham interchange and Pacific Park
- urban renewal of the land formerly used to run heavy rail
- state and federal government funding towards the creation of the University of Newcastle city campus, law and business faculties in the Civic precinct
- redevelopment of landholdings around Hunter Street Mall in the East End.

The transport program aspects of the NUTTP are an important part of the wider renewal of the Newcastle city centre. It will help improve pedestrian and vehicle connectivity within the CBD and promote public transport usage and accessibility.

The proposal

The proposal involves the construction and operation of a light rail system in the Newcastle city centre between Wickham and Pacific Park, and associated changes to the road and bus network, including:

- About 2.7 kilometres of light rail track, consisting of about 2.5 kilometres of dual track and 180 metres of single track.
- Six light rail stops and associated infrastructure (such as platforms, shelters and lighting):
 - Wickham Transport Interchange
 - Honeysuckle
 - Civic
 - Crown Street
 - Market Street
 - Pacific Park.
- A light rail stabling and maintenance facility at the location of the existing Wickham Station.
- Terminus facilities near the Pacific Park stop.
- Ancillary infrastructure, including two new substations, power supply, wiring and utilities.
- Works in the former rail corridor:
 - remove the existing Wickham Station buildings, platforms and pedestrian bridge
 - remove the pedestrian bridge located over the former rail corridor to the west of Market Street.
- Changes to existing bus stops along Hunter and Scott streets.
- Changes to intersections and the configuration of traffic lanes in a number of locations.

The location and key features of the proposal are shown in Figure E.1.

The scope of the proposal is the light rail system and related infrastructure, which is located primarily in the former rail corridor or on the existing roadway.

The area outside of this, between the kerb line and the shop fronts, and the broader urban amenity of the area surrounding the light rail route, will form part of a separate planning process.

Elements such as streetscapes (landscaping and street furniture) and cycleways, where they are related to the light rail proposal, will be further considered and subject to a separate assessment process at a later date. An extensive consultation program, focused on these aspects, will form part of this future planning process.

Construction timeframe

Construction of the proposal is forecast to start in late 2016. The proposal would take about two and a half years to complete, and would be complete in early 2019.



Figure E.1 Location and key features of the proposal

Environmental impact assessment

The purpose of the REF is to provide information about the proposal and summarise the results of the environmental impact assessment. Input to the REF has included:

- Specialist technical papers:
 - Technical Paper 1 – Traffic, transport and access assessment, prepared by GHD.
 - Technical Paper 2 – Noise and vibration assessment, prepared by GHD.
 - Technical Paper 3 – Statement of heritage impact, prepared by RPS.
 - Technical Paper 4 – Aboriginal heritage due diligence assessment, prepared by RPS.
 - Technical Paper 5 – Urban landscape and visual assessment, prepared by GHD.
 - Technical Paper 6 – Socio-economic assessment, prepared by GHD.
- Feasibility, option development and preliminary design reports prepared by GHD and PB/Aurecon in 2014.
- Conceptual design information on the proposal and the options considered, prepared by PB/Aurecon in 2014 and 2015.
- Desktop review of information readily available online and/or provided by TfNSW.

Community and stakeholder consultation

Community and stakeholder consultation for the proposal is being undertaken in three stages: prior to and during REF preparation, and in conjunction with the public display of the REF.

Community consultation during development of the proposal has been undertaken predominantly by UrbanGrowth NSW as part of the NUTTP. This consultation has included providing information about the overall program; urban transformation activities in the Newcastle city centre; development of the Wickham Transport Interchange; and the proposal. Consultation has been undertaken with the local community, including community organisations, businesses and focus groups in Newcastle and Maitland. Outcomes of the consultation are documented in an engagement outcomes report (UrbanGrowth NSW, 2015).

Key issues included:

- traffic, parking and access impacts
- ease of connectivity and integration with other transport modes
- noise impacts
- visual amenity impacts and opportunities to enhance the public domain
- impacts to listed heritage items
- potential impacts to businesses and the local community.

TfNSW will continue to work closely with key stakeholders and the community to minimise any impacts.

Current consultation

Formal consultation with stakeholders and the community will be undertaken in accordance with the requirements of *State Environmental Planning Policy (Infrastructure) 2007* during public display of the REF. Key engagement activities during the REF display period include advertisements, posters, community information sessions, stakeholder briefings and letterbox drops.

During the display period, the community and other stakeholders are invited to make written submissions to TfNSW on the proposal. Following the REF display, issues raised in submissions will be summarised in a submissions report. TfNSW will consider the issues raised and may make changes to the proposal as a result. A determination will then be made whether to proceed with the proposal.

If the proposal proceeds, TfNSW will continue to liaise with key stakeholders and the community during the detailed design development, construction, and operational phases of the proposal. This ongoing engagement process will play an important role in reducing the potential impacts and enhancing the benefits of the proposal for all stakeholders.

Future consultation

The NSW Government will work closely with Newcastle City Council, the community and other key stakeholders to develop ideas around urban amenity, including landscaping, kerbs and street furniture, particularly in the Hunter and Scott Street precincts.

Further consultation on these areas will be undertaken as part of a separate planning process, as the proposal progresses.

Summary of the key findings of the REF

Traffic, transport and access

The study area is located within an inner city traffic and transport environment, with a number of roads and a range of other transport facilities and infrastructure, including the railway, train stations, bus stops, pedestrian and cycle facilities.

The proposal would involve changes to the existing road configuration along Hunter and Scott streets, two new road crossings of the former rail corridor, a range of intersection works and changes to bus routes.

TfNSW is also currently consulting with Roads and Maritime and Council to confirm a package of additional road improvements along Stewart Avenue and King Street that would complement the introduction of the proposal. These works would be subject to a separate assessment.

The traffic and transport assessment involved extensive traffic modelling to assess the potential for impacts during construction and operation. The traffic model was updated and calibrated by a specialist traffic modeller in conjunction with technical input and review from NSW Roads and Maritime Services (Roads and Maritime) and Newcastle City Council (Council).

The assessment of the potential for construction impacts (for traffic, transport and access and other issues) was based on the preliminary construction methodology and plant outlined in chapter 7. This indicative methodology would be confirmed following appointment of a construction contractor and any substantive changes to the assumptions used may require additional assessment, mitigation and approvals prior to commencement.

Construction

Construction of the proposal would generate vehicle movements in and around the construction site and compound areas. Overall, the total number of vehicle movements in and around the construction site would be low compared to the existing traffic volumes, and would not result in a substantial impact on the local roads or the road network.

During construction, the number of traffic lanes in short sections of Hunter Street would be reduced to one lane in each direction. Modelling of this change indicated that, while there would be an increase in travel time due to the reduction in lane capacity, the overall performance of intersections would not substantially change.

Changes to on-street parking and some loading zones would be required to provide sufficient room for construction and to maximise the width of remaining traffic lanes during operation. This is discussed further below.

Operation

Traffic impacts

The inclusion of a separated running lane for light rail on Hunter Street would require removal of one vehicular traffic lane in each direction. This and the proposed road connections over the former rail corridor at Steel Street and Worth Place would also result in a redistribution of traffic in the western part of the study area, and onto King Street in particular.

Traffic modelling indicated that most intersections would perform satisfactorily in the year of opening. A 10 year future traffic scenario was also modelled, with the results showing that traffic conditions in 2028 would be mostly influenced by other developments and associated traffic generation, and not the proposal. With the proposal operational, the road network would generally operate at a satisfactory level, with only two intersections experiencing potential issues – the intersections of King Street/Union Street and Honeysuckle Drive/Hannell Street in the PM peak period. The intersection of Honeysuckle Drive and Hannell Street currently performs at a similar level of service without light rail due to issues currently experienced at this intersection.

Parking and loading zone impacts

A total of 267 on-street car parking spaces and 17 motorcycle parking spaces would need to be permanently removed to provide sufficient room for the operation of the proposal and remaining roadway. An additional 83 on-street car parking spaces would be affected in King Street for part of the day by a proposed peak period 'No Stopping' zone – 27 spaces on the northern side of the street during the AM peak period, and 56 spaces on the southern side of the street during the PM peak period.

A total of 29 spaces in loading zones, including three mail zones, would need to be removed and potentially relocated to other streets in the city centre.

A review of options to mitigate the loss of on-street parking and loading zones would be undertaken. The review would include both existing on-street and off-street parking locations as well as the opportunities provided by new or proposed developments or Government-owned land close to the proposal site. The review would include assessment of the potential options and identification of a preferred option/s. The review would be undertaken in consultation with relevant stakeholders, including surrounding businesses/organisations, Council, Roads and Maritime, and UrbanGrowth NSW.

Cycleway and buses

A review of options to support the provision of a dedicated east-west cycleway, potentially around King Street or the rail corridor, would be undertaken.

A revised city centre bus plan would be developed by TfNSW. The plan would confirm which bus routes would operate in Hunter Street and Scott Street following implementation of the proposal.

Noise and vibration

Baseline monitoring was undertaken between November and December 2014 to establish noise levels in each representative noise catchment area, and relevant construction and operation noise assessment criteria for the impact assessment. The assessment involved modelling to determine the predicted noise levels during construction and operation, and assess the potential for impacts.

Construction

In accordance with assessment guidelines, the potential noise emissions from construction have been predicted with a focus on those activities with the highest potential to cause noise impacts and assuming the loudest plant for each activity is operating continuously. The noise prediction results indicate that construction activities have the potential to impact surrounding sensitive residential receivers, and potentially non-residential receivers. However, it is noted that the predictions identify worst case noise levels, which may not be actually reached, or only infrequently reached, during the construction period. The assessment also indicated the potential for sleep disturbance impacts to result from out of hours works. It is proposed that further assessment and mitigation be considered once a construction contractor is appointed, and the preferred construction method and equipment is confirmed.

The construction assessment also indicated that vibration sensitive receivers (including heritage listed buildings/structures) are situated within the recommended vibration buffer distances, particularly along Hunter and Scott streets.

Construction noise and vibration mitigation measures, which have been successfully used on other similar projects, would be implemented in accordance with TfNSW's *Construction Noise Strategy* (TfNSW, 2012). As necessary, additional measures would be implemented where feasible and reasonable to reduce the potential for impacts.

Operation

The modelling results indicated that predicted daytime operational noise levels would comply with the trigger levels identified by the *Rail Infrastructure Noise Guideline* (EPA, 2013) at the majority of receivers, with exceedances predicted only for those receivers closest to the alignment. Further investigation of building façade performance is required to confirm the need for mitigation at non-residential locations.

Night time average and maximum noise levels are anticipated to exceed the *Rail Infrastructure Noise Guideline* trigger levels at a number of receivers. However, the existing noise environment along Hunter Street, Scott Street and in the vicinity of Stewart Avenue is dominated by road traffic noise, which leads to noise levels that are generally higher than the predicted noise levels from the proposal. An investigation of feasible and reasonable noise mitigation measures to minimise the predicted exceedances of noise criteria would be undertaken during the detailed design phase.

Any future developments in close proximity to the light rail route that may be affected by noise emissions must take into consideration *Development Near Rail Corridors and Busy Roads – Interim Guideline* (Department of Planning, 2008).

Other stationary noise sources associated with the proposal, including the stabling and maintenance facility, would be designed and operated to minimise the potential for exceedances of the noise criteria, following further analysis and specification during detailed design.

The predicted vibration levels for light rail operations indicate that the vibration goals for residential and commercial receivers would be met.

Heritage

The heritage impact assessment identified that the proposal would have the following direct impacts on listed heritage items/places:

- The removal of the locally listed Wickham Station and associated buildings/items.
- Works would be undertaken in the Newcastle City Centre Heritage Conservation Area.

- The eastern construction compound is located within the curtilage of the Newcastle Railway Station section 170 register listing.
- Impacts to listed archaeological sites – Cottage Creek Cemetery site, Palais Royale (Government Farm Archaeological Site) and the Convict Hut Archaeological Area – as a result of excavation/ground disturbance in these areas.
- Impacts to historic relics associated with excavation/ground disturbance in the areas of archaeological potential.

The locally listed 'Wickham Railway Station Group and Signal Box' would need to be removed to construct the proposal. Mitigation measures to ensure that these items are suitably archived and salvaged where appropriate have been provided in the REF. The design of the proposal would take into account its location within the Newcastle City Centre Heritage Conservation Area.

Construction activities may generate vibration at levels with the potential to impact on the structures of heritage items/buildings located close to the proposal site. Potential impacts would be minimised by adopting the recommended minimum offset distances for specified plant items, monitoring vibration levels at potentially affected structures where necessary, and responding appropriately to the results of monitoring.

Archaeological relics may be uncovered during the works. Applications for exemptions and/or permits under the *Heritage Act 1997* would be required to carry out excavation works. The potential for impacts on any unidentified relics or items would be minimised by implementing the measures provided in the REF.

Aboriginal heritage

An Aboriginal heritage due diligence assessment of the proposal was undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010).

Four Aboriginal sites have been previously recorded within the proposal site. No previously unrecorded sites were identified during the assessment, and it is noted that any evidence of Aboriginal occupation in the proposal site is likely to be located below the ground surface.

Based on the results of previous archaeological excavations in the vicinity of the proposal site, two areas (around Cottage Creek, and around Crown and Brown streets where a watercourse once existed) are considered to be archaeologically sensitive. The remainder of the area is considered to have moderate to low archaeological sensitivity.

In addition, there is the potential for Aboriginal objects to occur beneath the surface assumed to be part of historical disturbance. Excavation works may potentially impact on Aboriginal objects located in sub-surface archaeological deposits.

Mitigation measures to ensure protection of Aboriginal items and sites are provided in the REF. An Aboriginal Heritage Impact Permit (AHIP) would be sought from the NSW Office of Environment and Heritage prior to ground disturbance works. An application for the AHIP would be prepared and submitted in consultation with relevant Aboriginal stakeholders, as required under the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010).

Landscape character and visual impacts

The existing visual environment is characterised by its highly developed inner urban nature which includes a range of built form, paved areas and transport infrastructure.

The design of the stops and associated facilities (including the stabling and maintenance facility) provides an opportunity to reinforce the role of the proposal in the city centre urban renewal process. The urban design aspects would continue to be developed and refined during future design phases of the proposal. The final design of the proposal would take into account relevant considerations, including its location within the Newcastle City Centre Heritage Conservation Area; its role in the Newcastle city centre urban renewal process; the requirements of the NUTTP and relevant stakeholders; and the potential for urban design and visual impacts.

The proposal would generate temporary visual impacts during construction. Impacts would be experienced in the vicinity of work sites, most of which would move progressively along the route. Visible elements would include machinery and equipment, waste materials and the structures being constructed.

Socio-economic impacts

The proposal has the potential to result in the following benefits:

- Employment for up to 100 people in peak periods during construction, and about 60 people during operation.
- Some businesses providing convenience retail/food service in the vicinity of the proposal site may experience an increase in customers during construction.
- Revitalisation of the city centre by providing opportunities for better connections to the waterfront and through the city centre.
- Access to and within the city centre, which would benefit residents, workers, tourism and recreational visitors to and within the city centre.
- Long term benefits for some businesses in the vicinity of the light rail stops, which may experience increases in patronage as a result of people using the proposal.

The proposal may result in the following main socio-economic impacts:

- Changes to access within the study area during and following construction.
- A reduction in the availability of on-street parking, and changes to pedestrian and vehicle traffic, which have the potential to impact on businesses reliant on passing trade and accessible parking.
- Services along the proposal route and their customers/clients may be affected by access or amenity impacts during construction.

To manage these potential impacts, a Business and Organisation Management Plan would be developed and implemented with relevant stakeholders to provide a means of regular two-way communications between TfNSW, the construction contractor and affected stakeholders. Other management measures to minimise the impacts of the proposal, including a broader program of consultation, are provided in the REF.

Land use and property

The study area consists of a varied and relatively dense mix of land uses, including commercial, retail, residential, recreation/entertainment, community, health and education uses, and transport infrastructure.

The majority of the proposal site is or has been used for transport purposes (road and rail) and is public land (road or rail corridor) managed by Council or State Government agencies.

During construction, the use of the land would change temporarily from transport corridors and vacant land, to a construction site. Direct impacts on land use would be limited to temporary

land take and the short term presence of construction equipment, plant, vehicles and fenced work sites along the proposal site.

The operation of the majority of the proposal would not result in any impacts on land use. Although it would result in a change in the type of transport using transport corridors, it would involve the continued use of transport corridors for transport purposes.

Overall, it is expected that the proposal would integrate positively with the city centre urban renewal initiatives and significant development projects that are proposed or underway, by providing a public transport facility that can meet the needs of the future users of these developments.

Sustainability

A sustainability assessment of the proposal was undertaken. The results indicate that a gold rating under the *NSW Sustainable Design Guidelines* (TfNSW, 2014a), and an excellent rating under the Infrastructure Sustainability Council of Australia Infrastructure Sustainability Rating Tool, are both achievable for the proposal. The sustainability assessment would be updated as the proposal progresses.

A greenhouse gas and carbon footprint assessment would be undertaken during the detailed design stage, in accordance with TfNSW's *Carbon Estimate and Reporting Tool* and the *NSW Sustainable Design Guidelines*. This assessment would evaluate the sources of greenhouse gas emissions during the construction phase.

Other issues

In addition to the above, a range of other environmental issues were also considered to develop a comprehensive environmental management framework for the proposal. These issues included water quality, geology and soils, contamination and hazardous materials, flora and fauna, air quality, infrastructure and services, waste and cumulative impacts.

There is potential for cumulative construction impacts to be experienced at receivers adjacent to Beresford Street/Stewart Avenue resulting from simultaneous construction activity associated with both the Wickham Transport Interchange and the proposal. Co-ordination of works between the two construction crews would minimise disruption and reduce the duration of key construction activities where possible, by potentially undertaking interfacing works at the same time.

These and other impacts would be managed by the implementation of appropriate environmental management measures included in the construction environmental management plan for the proposal.

Next steps

During the public display period, stakeholders and the community are encouraged to make submissions to TfNSW in relation to the proposal. Following the display period, TfNSW will consider the issues raised in submissions and will respond to community feedback in a submissions report. The submissions report will also document the outcomes of ongoing investigations and design work identified in the REF.

TfNSW will then determine whether to proceed with the proposal. If the proposal proceeds, it would be undertaken in accordance with the mitigation measures proposed in the REF, the submissions report, and any conditions that form part of the determination.

Should any aspects of the proposal change following appointment of a construction contractor, additional investigations, assessment and approvals may be required in accordance with relevant legislation and TfNSW procedures.

As the project progresses, consultation with Council, community and key stakeholders will be undertaken on key aspects, such as urban amenity, parking, cycleways, and future route options.

Part A

Introduction

1. Introduction

1.1 Background to the proposal

The NSW Government is revitalising the Newcastle city centre. The revitalisation will reinforce the city's role as a 21st century regional centre, unlock the potential of the city centre as a place that can meet the needs of the current and future community, and boost economic activity across the Hunter Region.

The *Newcastle Urban Renewal Strategy*, a 25 year plan to revitalise Newcastle, was released by the NSW Government in December 2012. A key direction of this strategy is to achieve an integrated transport solution to help drive urban renewal and improve the linkage between the Newcastle city centre and the Newcastle Harbour waterfront. The *Newcastle Urban Renewal Strategy* (NSW Government, 2012) identifies transport, access and connectivity as a guiding principle for the urban renewal of Newcastle.

The key issues and requirements for undertaking urban renewal in the Newcastle city centre have also been considered by various other strategies and plans, including the *Lower Hunter Regional Strategy 2006-31* (Department of Planning, 2006), the *Hunter Street Revitalisation Final Strategic Framework* (City of Newcastle, 2010), the *Hunter Regional Transport Plan* (TfNSW, 2014b), and the *Draft Plan for Growing Hunter City* (NSW Government, 2015).

The Newcastle Urban Transformation and Transport Program (NUTTP) has been established to deliver the NSW Government's commitment to revitalise the city. The \$510 million program aims to bring people back to the city centre by strengthening connections between the city and the waterfront, creating employment opportunities, providing more public space and amenity, and delivering better transport.

UrbanGrowth NSW is coordinating this important program, working closely with NSW Planning and Environment, Transport for NSW (TfNSW), Hunter Development Corporation and Newcastle City Council (Council).

The NUTTP is underpinned by the following objectives that have been developed in consultation with the community:

- Bring people back to the city centre.
- Reconnect the city to its waterfront.
- Help grow new jobs in the city centre.
- Create great places linked to new transport.
- Create economically sustainable public domain and community assets.
- Preserve and enhance the city centre's heritage and culture.

The NUTTP is an integrated development and transport plan that comprises a number of urban redevelopment / renewal projects supported by a transport program of works.

The transport program seeks to revitalise Newcastle by improving pedestrian and vehicle connectivity within the CBD and by promoting public transport usage and accessibility.

The key public transport components of the NUTTP are:

- Truncating and removing the existing Newcastle heavy rail branch line from Newcastle to Wickham.

- Constructing the new transport interchange west of Stewart Avenue at Wickham to facilitate the movement of people between transport modes including heavy rail, light rail, buses and taxis.
- Delivery of a new light rail system from Wickham to Newcastle.
- Investigating the potential to extend the light rail network in Newcastle.

The transport components of the NUTTP are an important part of the wider renewal of the Newcastle city centre. The transport projects aim to reconnect the Newcastle CBD to its waterfront and make it easier to move around the city centre. The transport projects will drive the economic growth and renewal of Newcastle as part of an integrated land use and transport strategy.

Newcastle's new transport interchange at Wickham has received planning approval, and work began on the new interchange following truncation of the heavy rail line on 26 December 2014. TfNSW is now proposing to progress development of the Newcastle Light Rail Project. The construction and operation of the Newcastle Light Rail Project is referred to as 'the proposal' in this document.

GHD Pty Ltd (GHD) was commissioned by TfNSW to undertake an assessment of the potential environmental impacts of the proposal and prepare a review of environmental factors (REF) in accordance with the provisions of Part 5 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act).

1.2 Key features of the proposal

1.2.1 Location

The location of the proposal site (the area that would be directly affected by construction works) is shown in Figure 1.1. The proposal site is generally located in the former heavy rail corridor ('the former rail corridor') east of the Wickham Transport Interchange to Worth Place, where it would diverge onto Hunter Street and subsequently, Scott Street, terminating near Pacific Park.

1.2.2 Key features

The proposal involves the construction and operation of a light rail system in the Newcastle city centre between Wickham and Pacific Park, and associated changes to the road and bus network. This would include:

- About 2.7 kilometres of light rail track, consisting of about 2.5 kilometres of dual track and 180 metres of single track.
- Six light rail stops and associated infrastructure (such as platforms, shelters and lighting):
 - Wickham Transport Interchange
 - Honeysuckle
 - Civic
 - Crown Street
 - Market Street
 - Pacific Park.
- A light rail stabling and maintenance facility at the location of the existing Wickham Station.
- Terminus facilities near the Pacific Park stop.
- Ancillary infrastructure, including two new substations, power supply, wiring and utilities.

- Works in the former rail corridor:
 - remove the existing Wickham Station buildings, platforms and pedestrian bridge
 - remove the pedestrian bridge located over the former rail corridor to the west of Market Street.
- Changes to existing bus stops along Hunter and Scott streets.
- Changes to intersections and the configuration of traffic lanes in a number of locations.

Further information on the proposal is provided in chapter 6.

1.3 Scope of the REF

1.3.1 Purpose of the REF

Section 111 of the EP&A Act imposes a duty on TfNSW to ‘examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment’ by reason of the proposal. Under the provisions of Part 5, TfNSW is required to determine whether to proceed with the proposal, and what impact mitigation or environmental management measures are required.

The purpose of this REF is to summarise the results of the environmental impact assessment and provide information about the proposal as an input to the section 111 determination process. TfNSW will consider the findings of this REF as part of the determination process.

In summary, the REF will assist TfNSW undertake the following:

- Determine whether the proposal should proceed to construction, taking into account to the fullest extent possible all matters affecting or likely to affect the environment (in accordance with section 111 of the EP&A Act)
- Determine whether the proposal is likely to have a significant effect on the environment or significantly affect threatened species, populations or ecological communities or their habitats, and identify appropriate mitigation measures.

1.3.2 Methodology

The REF has been prepared in close consultation with technical advisors, relevant government agencies and stakeholders. Preparing the REF has involved:

- Receiving relevant information.
- Undertaking site visits.
- Reviewing information on the definition and pre-concept designs for the proposal.
- Undertaking specialist impact assessment studies in relation to traffic and transport, noise and vibration, heritage, socio-economic impacts and visual amenity.
- Desktop assessments of other potential environmental issues.
- Attending meetings and workshops with key agencies, technical advisors engaged for the proposal, and other stakeholders.



Figure 1.1 Location and key features of the proposal

The REF is supported by the following specialist technical papers:

- Technical Paper 1 – Traffic and transport assessment.
- Technical Paper 2 – Noise and vibration assessment.
- Technical Paper 3 – Statement of heritage impact.
- Technical Paper 4 – Aboriginal heritage due diligence assessment.
- Technical Paper 5 – Urban landscape and visual assessment.
- Technical Paper 6 – Socio-economic assessment.

Input to the REF has also included the following:

- Feasibility, option development and preliminary design reports prepared by GHD and PB/Aurecon in 2014.
- Conceptual design information on the proposal and the options considered, prepared by PB/Aurecon in 2014 and 2015.
- Desktop review of information readily available online and/or provided by TfNSW.

1.3.3 Structure

The structure of the REF is outlined below:

Part A – Introduction and context

- Chapter 1 – provides an introduction to the REF.
- Chapter 2 – describes the location of the proposal, the proposal site and study area.
- Chapter 3 – summarises the statutory requirements for the proposal, including the requirements of relevant environmental planning instruments and legislation.
- Chapter 4 – describes the community and stakeholder consultation process and the key issues raised to date.

Part B – The proposal

- Chapter 5 – defines the strategic context and need for the proposal, and the options development process.
- Chapter 6 – describes the proposed light rail infrastructure, changes to the transport network, and an overview of how the proposal would operate.
- Chapter 7 – describes how the proposal would be constructed.

Part C – Environmental impact assessment

- Chapters 8 to 14 – summarises the results of the assessment of the key environmental impacts, including the results of technical papers prepared as an input to the REF.
- Chapter 15 – considers other potential environmental impacts associated with the proposal and how these would be managed.

Part D – Environmental management and conclusion

- Chapter 16 – describes the requirements for environmental management during construction and operation, and provides an outline of the construction environmental management plan (CEMP).
- Chapter 17 – summarises the mitigation measures listed in chapters 8 to 15.
- Chapter 18 – provides a conclusion to the REF.

2. Location and setting

This chapter provides information on the proposal site for the purposes of the REF and the general setting for the proposal site (the study area).

2.1 Proposal site location and description

The proposal site is located in the suburbs of Newcastle, Newcastle West and Newcastle East in the Newcastle city centre. The proposal site extends in an east/west direction across the city centre, within the former rail corridor and road reserves. It is bounded to the west by the Wickham Transport Interchange near Stewart Avenue. From the Wickham Transport Interchange, the proposal site extends east along Beresford Street and enters the now unused section of the heavy rail corridor (referred to in this REF as ‘the former rail corridor’) near the existing Wickham Station buildings. The proposal site is located within the former rail corridor from this point until near Worth Place, where it enters the road corridor and travels along Hunter Street, and Scott Street to the northern side of Pacific Park.

The proposal site also includes the proposed location for the substations in the former rail corridor to the west of Argyle Street, and the proposed location for the stabling and maintenance facility at the site of the existing Wickham Station.

The proposal site is shown in Figure 2.1.

A description of the proposed alignment of the light rail corridor is provided in chapter 6. Information on the existing environment of the proposal site is provided in Part C of the REF.

2.2 The study area

The study area for the proposal is defined as the wider area surrounding the proposal site, which is the area that has the potential to be directly or indirectly affected by the proposal (for example, by noise and vibration, visual or traffic impacts).

The study area is within the City of Newcastle local government area (the Newcastle LGA), which is located about 160 kilometres north of Sydney, within the Lower Hunter region. Newcastle is the second largest city in NSW, and is the major centre for the Lower Hunter region. The city supports a range of regional services focused around transport, education and health.

Characteristic of its inner urban location, the study area consists of a varied and relatively dense mix of land uses, including commercial, retail, residential, recreation/entertainment, community, health and education uses, and transport infrastructure. The key features of the study area are shown in Figure 2.1 and Figure 2.2. Further information on the land uses surrounding the proposal site is provided in chapter 14.

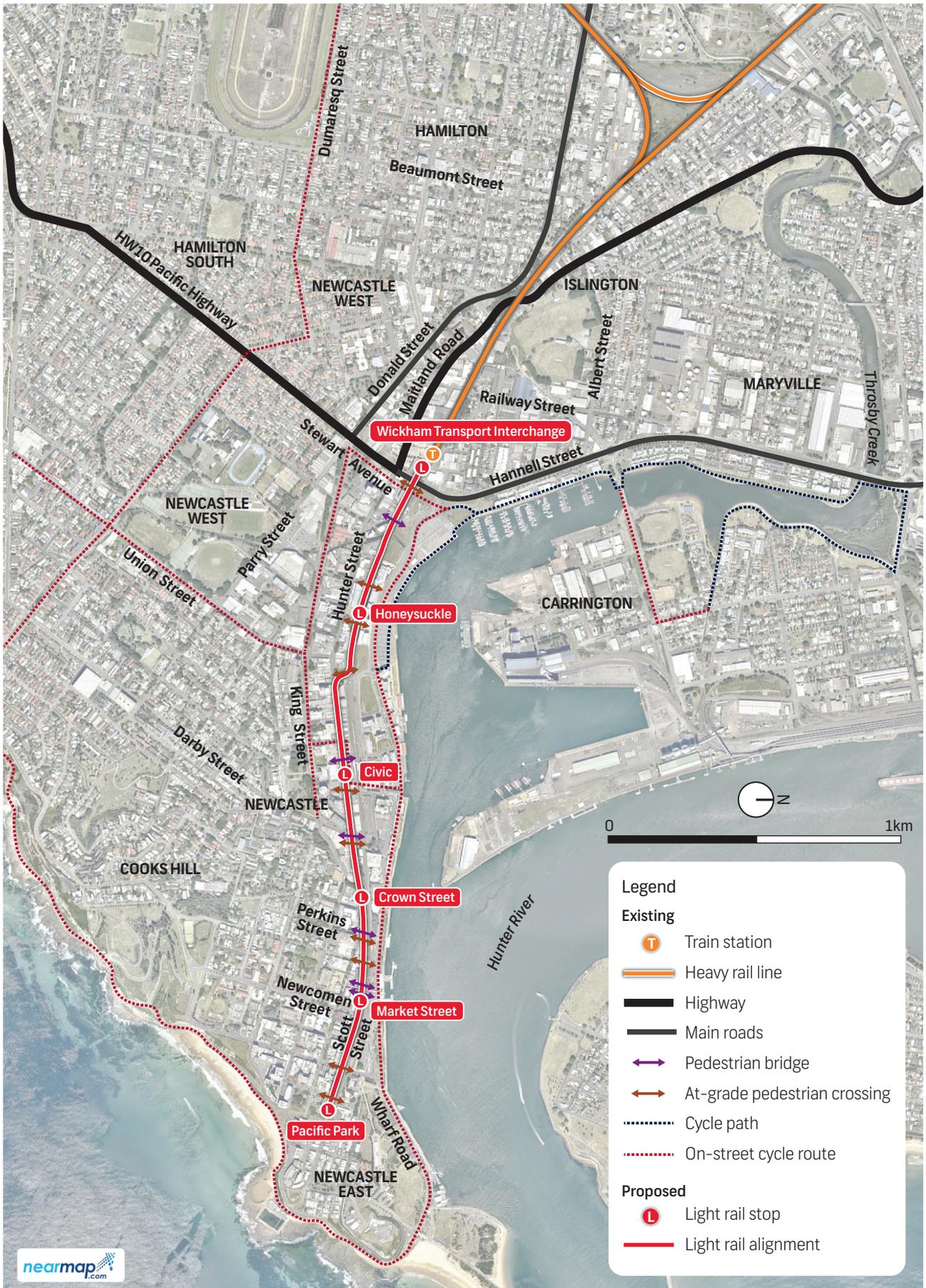


Figure 2.2 Key transport features of the study area

3. Statutory considerations

This chapter provides a review of the legislation and environmental planning instruments that are relevant to the environmental assessment and determination of the proposal. The permissibility and approval pathway is considered in section 3.1. Other planning instruments and legislation that are relevant to the assessment and determination of the proposal are considered in sections 3.2 and 3.3.

3.1 Approvals pathway

3.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (the Regulation) provide the framework for development assessment in NSW. The EP&A Act and the Regulation include provisions to ensure that the potential environmental impacts of a development are considered in the decision making process prior to proceeding to construction.

As described below, the proposal would be permitted without consent in accordance with *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP), and the proposal is subject to the assessment requirements of Part 5 of the EP&A Act.

State Environmental Planning Policy (Infrastructure) 2007

Section 8 ('Relationship to other environmental planning instruments') of the Infrastructure SEPP provides that if there is an inconsistency between this Policy and any other environmental planning instrument, this Policy prevails to the extent of the inconsistency.

Clause 79(1) of the Infrastructure SEPP provides that development for the purpose of a 'railway' or 'rail infrastructure facilities' may be carried out by or on behalf of a public authority without consent on any land. The proposal would meet the definition of rail infrastructure facilities provided in clause 78, and would be permitted without consent under clause 79(1).

Once the route for the proposal is declared to be the route of a light rail system under the *Transport Administration Act 1988* (refer to section 3.1.2), the proposal would also be permitted without consent as a result of the application of that Act.

Clauses 13 to 16 of the Infrastructure SEPP outline the requirements for consultation with councils and other public authorities for any infrastructure development carried out by or on behalf of a public authority that meets the requirements under these clauses. A summary of the consultation undertaken for the proposal is provided in chapter 4.

Duty to consider environmental impacts

For activities subject to assessment under Part 5, section 111 of the EP&A Act imposes a duty on a determining authority to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment' by reason of the proposal.

Under section 112(1)(a) of the EP&A Act, an environmental impact statement is required for 'an activity that is likely to significantly affect the environment (including critical habitat) or threatened species, populations or ecological communities or their habitats'.

TfNSW has undertaken an assessment of the potential significance of the impacts of the proposal (GHD/RPS, 2014). The assessment concluded that the proposal would be unlikely to result in any significant long term impacts to the environment. As a result, TfNSW concluded that an environment impact statement would not be required.

State significant development/infrastructure

State significant development and State significant infrastructure are defined by section 89C and clause 115U (respectively) of the EP&A Act and *State Environmental Planning Policy (State and Regional Development) 2011* (the State and Regional Development SEPP).

As noted above, TfNSW has determined, in accordance with section 112(1) of the EP&A Act, that an environmental impact statement is not required. As a result, the proposal does not meet the definition of State significant infrastructure under section 115U(3).

The proposal does not meet the definitions of State significant development.

Local environmental plans

The *Newcastle Local Environmental Plan 2012* (the LEP) applies to the land on which the proposal site is located. Irrespective of the provisions of the LEP, the proposal is permitted without consent as a result of the application of the Infrastructure SEPP. As a result, the LEP does not apply to the proposal.

3.1.2 Transport Administration Act 1988

Section 104N(1) of the *Transport Administration Act 1988* defines a 'light rail system' as:

...a system for the provision of light rail services along a route declared under subsection (2), including tracks, catenaries, supports for tracks and catenaries, stops, access to stops, signalling and other control facilities, vehicles, vehicle depots and other facilities and equipment associated with the provision of those services.

Section 104N(2) of the Act states that the regulations may declare a route along a road or through other land to be the route of a light rail system. In accordance with section 104P, development for the purposes of a light rail system may be carried out without development consent under Part 4 of the EP&A Act. Specifically, section 104P states:

(2) *Development for the purposes of a light rail system:*

(a) *may be carried out without the necessity for development consent under Part 4 of the EPA Act, and*

(b) *may be so carried out even if the development would be prohibited, or would require development consent, in the absence of this section.*

(3) *Development for the purposes of a light rail system is an activity within the meaning of Part 5 of the EPA Act and TfNSW is the proponent and a determining authority in relation to that activity for the purposes of that Part*

(4) *Development for the purposes of a light rail system includes anything that is incidental to the carrying out of any such development.*

The above provisions provide that, once the route for the proposal is declared in accordance with the requirements of section 104N(2), the proposal would meet the definition of 'light rail system' provided by section 104N.

3.2 Requirements under other NSW environmental planning instruments and legislation

Other environmental planning instruments and legislation that are directly relevant to the approval/determination and/or assessment of the proposal is considered in Table 3.1.

Table 3.1 Consideration of requirements under other NSW environmental planning instruments and legislation

Act	Potential approval requirements	Relevance to the proposal
SEPPs		
<i>State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55)</i>	SEPP 55 specifies the consent requirements for remediation activities.	<p>Contamination investigations were completed as an input to the design (PB, 2015) and the results are summarised in section 15.4.</p> <p>Exceedances of the health investigation level criteria (for benzo(a)pyrene and lead) were identified by the contamination report at two locations. The proposal would only involve works in the vicinity of one of these locations. Measures are provided in sections 15.4.4 and 16.3 to manage the identified contamination. Measures are also provided to manage the potential for health and environmental impacts associated with any hazardous materials (such as asbestos) that may be disturbed during construction. These measures would be implemented to ensure there are no impacts to human health or the environment.</p> <p>Environmental management works are permitted without consent under clause 79(2)(d) of the Infrastructure SEPP. It is considered that any remediation work would meet the definition of environmental management works, and would not require consent.</p>
NSW Acts		
<i>Contaminated Land Management Act 1997</i>	The Act requires that landowners and persons who carry out contaminating activities must notify contamination of land in the circumstances specified in section 60 of the Act.	The NSW Environment Protection Authority (EPA) must be notified in writing of any contamination identified within the proposal site in accordance with the requirements of section 60 of the Act.
<i>Heritage Act 1977</i>	<p>Approval under section 57(1) for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register. The form of the application is specified by section 60.</p> <p>Section 57(2) provides that an exemption from the approval requirements of section 57(1) can be sought in certain circumstances.</p> <p>An excavation permit is required under sections 139(1) and (2) to disturb or excavate any land containing or likely to contain a relic. The form of the application is specified by section 140.</p> <p>Section 139(4) provides that exceptions from the approval requirements of sections 139(1) and (2) can be sought in certain circumstances.</p>	<p>A statement of heritage impact was prepared for the proposal.</p> <p>An excavation exception application under section 139(4) would be sought prior to construction in the identified archaeological areas.</p> <p>An approval under section 140 of the Heritage Act would be required to impact on the footings of the former Honeysuckle Station in archaeological area 3.</p> <p>If during works, substantial intact archaeological relics of State or local significance are uncovered, work must cease in the affected area and the Heritage Council must be notified in writing. Depending on the nature of the discovery, additional assessment, and possibly an excavation permit, may be required prior to the recommencement of excavation in the affected area.</p> <p>Further information is provided in chapter 10.</p>

Act	Potential approval requirements	Relevance to the proposal
<i>Mine Subsidence Compensation Act 1961</i>	Under section 15, approval is required to alter or erect improvements within a mine subsidence district.	The proposal site is located within the Newcastle Mine Subsidence District. If TfNSW determines to proceed with the proposal, it would consult with the Mine Subsidence Board and seek any approvals necessary, prior to commencement of construction.
<i>National Parks and Wildlife Act 1974</i>	An Aboriginal heritage impact permit (AHIP) under section 90 of the Act to harm or desecrate an Aboriginal heritage object.	An Aboriginal heritage due diligence assessment of the proposal was undertaken. The assessment identified four Aboriginal sites which extend into the proposal site. The assessment concludes that there is the potential for Aboriginal objects to occur beneath the surface layer of historical disturbance. As the proposal would involve excavation and is likely to encounter Aboriginal objects, an AHIP application would be prepared for the entire proposal site, supported by an Aboriginal Cultural Heritage Assessment Report (ACHAR). Aboriginal consultation would be undertaken in accordance with the <i>Aboriginal Cultural Heritage Consultation Requirements for Proponents</i> (DECCW, 2010). This consultation has commenced, and further information is provided in chapter 11.
<i>Noxious Weeds Act 1993</i>	Under Part 3 Division 1 of the Act, all private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land.	The approach to managing weeds during construction is provided in Table 16.1.
<i>Protection of the Environment Operations Act 1997</i>	An environment protection licence (EPL) is required for scheduled activities or scheduled development work. Scheduled activities requiring a licence relevantly include: <ul style="list-style-type: none"> • railway systems activities (clause 33) meaning: <ul style="list-style-type: none"> – (a) the installation, on site repair, on-site maintenance or on site upgrading of track, including the construction or significant alteration of any ancillary works, or – (b) the operation of rolling stock on track – where track means railway track that forms part of, or consists of, a network of more than 30 kms of track • land based extractive activities that involve the extraction, processing or storage of more than 30,000 tonnes of material per year (clause 19). 	The proposal would not meet the current definition of railway systems activities. The need for an EPL would be confirmed in consultation with the EPA. The proposal would need to comply with the general obligations of the POEO Act.
<i>Roads Act 1993</i>	Approval under sections 138 and 144C for works to a public roads and consent for works relating to a light rail system.	The proposal would involve impacts to public roads. If TfNSW determines to proceed with the proposal, it would seek approval from NSW Roads and Maritime Services (Roads and Maritime) prior to commencement of construction.

Act	Potential approval requirements	Relevance to the proposal
<i>Threatened Species Conservation Act 1995</i>	The TSC Act lists threatened species, populations or ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If any of these could be impacted by a project, an assessment of significance that addresses the requirements of section 5A of the EP&A Act must be completed to determine the significance of the impact.	The flora and fauna assessment has addressed these requirements (refer section 15.5). No significant impacts are predicted.
<i>Water Management Act 2000 and Water Act 1912</i>	Licence for dewatering and interception of groundwater. Any dewatering activity that is estimated to exceed 3 ML/yr must obtain a licence under Part 5 of the <i>Water Act 1912</i> prior to commencing the activity.	Excavation work would be undertaken as part of the proposal. Although it is likely that groundwater would be intercepted and dewatering would be required, it is unlikely that it would exceed 3 ML/year. TfNSW would consult with the NSW Office of Water following detailed design should any approvals be required.

3.3 Approvals under Commonwealth legislation

An *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protected matters search was undertaken on 10 March 2015 for an area within a ten kilometre radius of the proposal site. The results of the search are summarised in Table 3.2. As no impacts are predicted, an approval under the EPBC Act would not be required.

Table 3.2 EPBC Act protected matters search results

Protected matter	Matter located within search radius	Comments	Potential impact
World Heritage Property	None	The proposal would not impact on any World Heritage properties.	None
National Heritage Places	Fort Wallace Nobbys Lighthouse	The proposal would not impact on these places.	None
Wetlands of international significance (Ramsar sites)	Hunter estuary wetlands	The proposal would not impact on any wetlands.	None
Threatened ecological communities	Lowland Rainforest of Subtropical Australia Subtropical and Temperate Coastal Saltmarsh	The proposal would not impact on any threatened ecological communities.	None
Threatened species	59 threatened species, including 24 birds, two frogs, one fish, nine mammals, 13 plant species, six reptiles and four marine species	The proposal is located within a disturbed urban area with limited vegetation (native or otherwise) that would provide habitat for threatened or migratory species. The proposal would not result in a significant impact on any threatened or listed migratory species.	None
Listed migratory species	70 migratory species, including 25 wetland species, 20 migratory marine birds, 18 other marine species and seven terrestrial species		None

Protected matter	Matter located within search radius	Comments	Potential impact
Nuclear actions	None	The proposal does not involve a nuclear action.	None
Commonwealth Marine Areas	None	No Commonwealth marine areas are located within the search radius.	None
Great Barrier Reef Marine Park	None	The Great Barrier Reef Marine Park is outside the search radius.	None
Commonwealth land	16 Commonwealth properties	The proposal would not directly or indirectly impact on any Commonwealth land.	None
A water resource, in relation to coal seam gas development and large coal mining development	Not relevant	Not relevant	None

3.4 Summary of approval requirements

The proposal is permissible without consent under the Infrastructure SEPP and is subject to assessment and determination in accordance with Part 5 of the EP&A Act. The proposal does not meet the definitions of State significant development or State significant infrastructure, and an environmental impact statement is not required.

The following approvals/licences and exception applications are considered to be required:

Non-Aboriginal heritage and archaeology

- Excavation exception applications under section 139(4) of the Heritage Act prior to construction in archaeological areas 1 and 4 (exception type S139(1C)) and archaeological areas 2, 3 and 5 (exception type S139(1B)).
- Approval under section 140 of the Heritage Act for impacts to the footings of the former Honeysuckle Station in archaeological area 3.
- If any substantial intact archaeological relics of State or local significance are uncovered during construction, the Heritage Council would be notified in writing in accordance with section 146 of the Heritage Act. Depending on the nature of the discovery, additional assessment and possibly an excavation permit may be required prior to the recommencement of excavation in the affected area.

Aboriginal heritage

- An AHIP under section 90 of the *National Parks and Wildlife Act 1974* for the entire proposal site.

Other

- A section 138 approval under the *Roads Act 1993* for works in Stewart Avenue.
- Approval from the Mine Subsidence Board under section 15 of the *Mine Subsidence Compensation Act 1961* for works within a mine subsidence area.

3.5 The assessment process

The first stage of the assessment process has involved preparing this REF. An outline of the REF methodology is provided in chapter 1.

The REF will be displayed and made publicly available. During the display period, key stakeholders and the community are encouraged to make submissions to TfNSW on the proposal and any potential environmental impacts.

Following the display period, TfNSW will consider issues raised in submissions and will respond to community feedback in a submissions report. If required, TfNSW may also propose changes to the proposal and detail these in the submissions report. These documents will be available to the public on the TfNSW website.

Following preparation of the submissions report, TfNSW will determine whether to proceed with the proposal. If TfNSW proceeds with the proposal, it would be carried out in accordance with the mitigation measures outlined in this REF and submissions report, and any conditions that form part of the determination under Part 5 of the EP&A Act.

The key steps in the assessment process under Part 5 of the EP&A Act are shown in Figure 3.1.

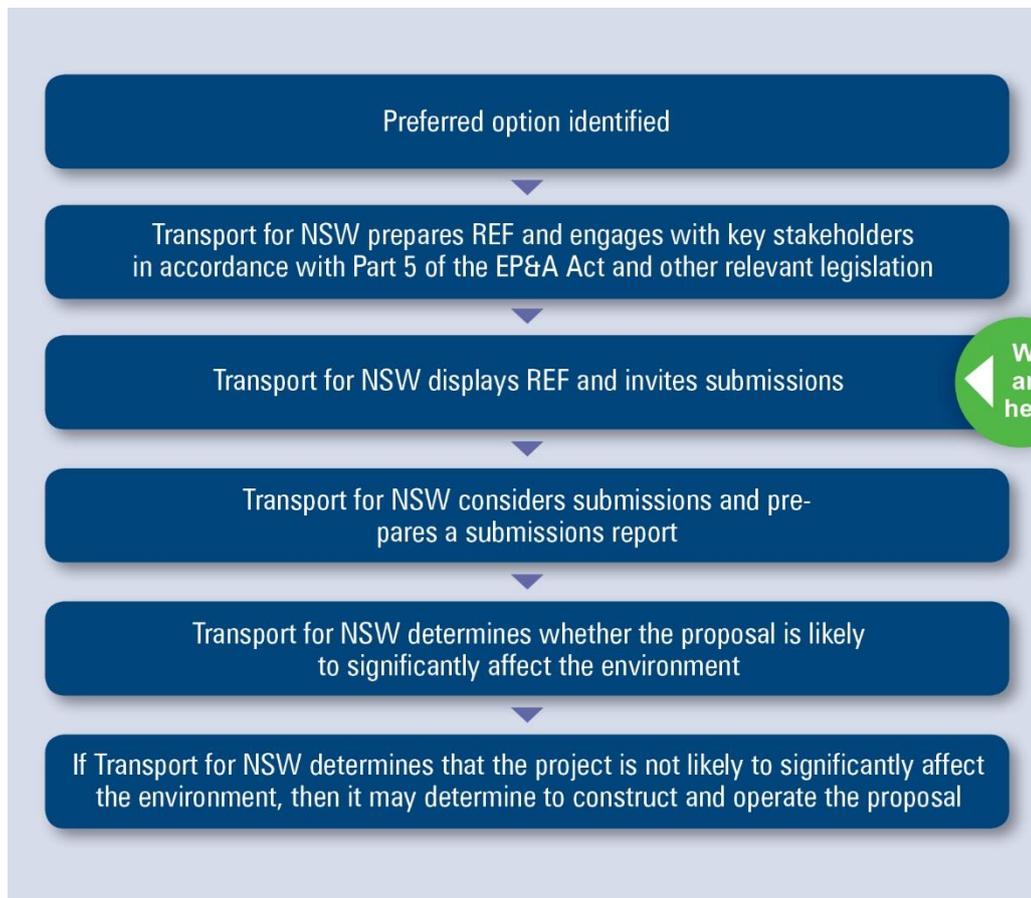


Figure 3.1 The assessment process

4. Community and stakeholder consultation

This chapter summarises the community and stakeholder consultation undertaken prior to and during preparation of the REF, and the consultation proposed to be undertaken during the public display period.

4.1 Consultation objectives and approach

Consultation for the proposal aims to encourage stakeholder and community involvement in the design and assessment process. The approach to consultation is based on providing best practice consultation consistent with TfNSW's *Community Engagement Policy*. The objectives of consultation for the proposal are to:

- Ensure that the local community and stakeholders are informed about the proposal and given the opportunity to provide feedback.
- Provide stakeholders with an opportunity to ask questions and identify areas of concern.
- Ensure that concerns and issues raised by the community and key stakeholders are considered during the REF process.
- Implement a planned approach to community and stakeholder communication.
- Effectively and proactively identify and manage local issues.

4.2 Consultation prior to REF preparation

Consultation during development of the proposal has been undertaken predominantly by UrbanGrowth NSW as part of the NUTTP. This consultation included providing information about the overall program; UrbanGrowth's proposed urban transformation activities in the Newcastle city centre; development of the Wickham Transport Interchange; and the Newcastle Light Rail project.

Consultation was undertaken during 2014 and 2015 with the local community, including community organisations, businesses and other stakeholders in Newcastle and Maitland. Feedback on transport-related issues was collected by UrbanGrowth NSW and provided to TfNSW to inform this REF. A summary of the main consultation activities undertaken, and the key issues raised that are relevant to the proposal, is provided below.

4.2.1 Newcastle Light Rail project consultation

In early 2014, UrbanGrowth NSW and TfNSW undertook a consultation process to gather community views about introducing light rail to the Newcastle city centre. The consultation activities that were undertaken are summarised in Table 4.1.

Table 4.1 Consultation activities during initial consultation on the Newcastle Light Rail project

Activity	Purpose and detail
Invitations	Invitations to community engagement forums were emailed to industry, businesses, and community groups in the Newcastle and Maitland LGAs. Invitations were also hand delivered to local businesses along Hunter Street. Flyers inviting community members to the information and feedback sessions were distributed throughout the consultation period. These were hand delivered to businesses and to passers-by in Wharf Road, Hunter Street, Wheeler Place and Newcastle Station.
Summary brochure	A brochure providing information was made available at all forums, information sessions and online.
Council briefings	Council briefings occurred on: <ul style="list-style-type: none"> Newcastle City Council – 24 February 2014 Maitland City Council – 25 February 2014
Engagement forums	Forums were held with industry, key business and community groups on: <ul style="list-style-type: none"> Industry forum – 27 February 2014 local business forum – 28 February 2014 Newcastle community group forum – 5 March 2014 Maitland community group forum – 6 March 2014
Community information and feedback sessions	Six community information sessions were held to provide further information about the proposal and facilitate community feedback. These sessions included: <ul style="list-style-type: none"> Newcastle – 8 and 11 March 2014 Maitland – 10 March 2014 focus groups – 3, 4 and 5 March 2014
Newspaper advertisements	Advertisements were placed in local newspapers to inform the community about the proposal and community information and feedback sessions: <ul style="list-style-type: none"> Newcastle Herald – 27 February 2014 Maitland Mercury – 28 February 2014
Community contact and feedback mechanisms	Contact details were established to enable stakeholders to provide feedback and ask questions of the project team. The following contact mechanisms were advertised in all communication material: <ul style="list-style-type: none"> website: dedicated project website updated with new information when available email: managed throughout normal working hours, with enquiries responded to promptly project information phone line: staffed from 9am to 5.30pm, Monday to Friday, with a message service for out-of-hours calls mail: UrbanGrowth NSW's Newcastle postal address.

4.2.2 Design Newcastle consultation 2014

In June and July 2014 UrbanGrowth NSW ran a two-month community engagement program, referred to as Design Newcastle, to help shape the revitalisation of the Newcastle city centre. Over 950 stakeholders participated, including individuals, community groups, and representatives from local councils and NSW Government agencies. Engagement activities involved two all-day summits held with community members, small group meetings, telephone survey and online discussions, forums and polls.

Relevant key findings from this consultation include:

- 54 per cent of participants indicated they would be likely or very likely to use light rail.
- 77 per cent of participants indicated that reconnecting the Hunter River foreshore to the city centre is one of the most important needs for the city.

- Participants strongly supported activities that encourage the establishment of innovative businesses in the city centre, with 80 per cent of participants supporting the creation of a high tech, enterprise zone.

4.2.3 Revitalising Newcastle consultation 2015

Another round of community engagement, known as Revitalising Newcastle, was conducted over six weeks in August and September 2015 by UrbanGrowth NSW in conjunction with Council. Consultation focused on the opportunities for revitalisation identified during the previous consultation. Key outcomes included:

- Revitalising Newcastle attracted a high level of interest from the community, with more than 1,400 people from more than 40 Hunter region postcodes participating in 13 face-to-face community events.
- About 11,000 individuals visited the Revitalising Newcastle website.
- 250 city centre businesses were contacted via doorknocks.
- More than 2,600 people participated in surveys held across Newcastle and the Lower Hunter region, by phone, online and face-to-face, including through Council's online community reference panel Newcastle Voice.
- Stakeholder briefings were held with more than 15 stakeholder and community groups representing community interests, local business, Aboriginal, and culturally and linguistically diverse communities, and people with a disability.

Overall, 285 submissions were received, mainly (about 91 per cent) from individuals. The majority of submissions received related to the heavy rail truncation and building light rail in Newcastle. The main themes raised in submissions were:

- Support for the former rail corridor to remain a transport corridor.
- A preference for light rail to use the former rail corridor.
- Concerns about the capacity of Hunter and Scott streets to support shared running of light rail.
- A preference for light rail to be delivered with shared cycle and pedestrian paths.
- Support for light rail to be extended in the future, including to the University of Newcastle, John Hunter Hospital, Mater Hospital, and a 'loop' from the city centre to the city beaches.
- Concern over the cost of the light rail proposal and a view that these funds could be used on other projects in Newcastle.
- Concern about construction impacts, including impacts on local business, traffic, amenity, and health and safety.

The *Revitalising Newcastle Engagement Outcomes Report* was released by UrbanGrowth NSW in December 2015. A planning proposal (including concept plans) to rezone land in the former rail corridor will be prepared by UrbanGrowth NSW and lodged with Council. The planning proposal will be placed on public exhibition by Council.

4.3 Consultation during REF preparation

During preparation of the REF, TfNSW consulted extensively with key stakeholders, including Roads and Maritime, UrbanGrowth NSW, and Council to confirm various aspects of the proposal, and ensure that the planning and design aligns with future plans and strategies.

4.3.1 Consultation strategy

Community and stakeholder consultation is guided by the *Newcastle Light Rail Project REF Stakeholder Engagement Plan*, which was developed by GHD in conjunction with TfNSW. The plan:

- provides background information about the proposal
- identifies the community and key stakeholders with the potential to be affected by the proposal
- identifies the potential nature and extent of stakeholder issues/concerns and relevant strategies to manage these proactively
- defines key messages, and identifies the communication tools and techniques to disseminate information and provide opportunities for feedback
- documents the policies and procedures implemented to record and respond to enquiries, complaints, and issues
- identifies and allocates roles and responsibilities
- provides an overview of how the effectiveness of the strategy will be evaluated.

The consultation strategy provides for consultation to be undertaken in two stages:

- before public display of the REF
- in conjunction with public display of the REF.

4.3.2 Consultation activities before public display of the REF

The objective of consultation before public display of the REF was to ensure stakeholders were aware of the proposal and were informed of the REF. Table 4.2 lists the key engagement activities and tools provided by the Stakeholder Engagement Plan, outlines their purpose, and describes how each tool/activity has been and/or will be used to engage the community and other stakeholders.

Table 4.2 Consultation activities during REF preparation

Activity	Purpose and detail
Stakeholder identification and analysis mapping	A desktop search and site visit was undertaken to identify stakeholders within/close to the proposal site and those likely to have an interest in the construction and operation of the proposal.
Community contact and feedback mechanisms	Contact mechanisms were established to enable stakeholders to provide feedback on the proposal and ask questions of the proposal team. The following contact mechanisms were advertised in all communication material: <ul style="list-style-type: none">• project information line: 1800 684 490• email: projects@transport.nsw.gov.au• website: www.transport.nsw.gov.au/projects Contact details, issues raised, and responses provided are recorded in a project-specific consultation database.

4.4 Consultation during public display

The REF will be placed on public display for a period of six weeks, during which time written submissions will be accepted. The REF will be displayed at the following locations:

- City of Newcastle City Administration Centre, 282 King Street, Newcastle
- Newcastle City Library, Ground Floor, Laman Street Newcastle
- Hamilton Library, 44 James Street, Hamilton
- TfNSW, ground floor, 239 King Street, Newcastle
- TfNSW Community Information Centre, 388 George Street (at the corner of King Street), Sydney
- TfNSW website www.transport.nsw.gov.au/projects and the NSW Government Have Your Say website www.haveyoursay.nsw.gov.au.

Ongoing discussions will be held with key stakeholders during the display period, including:

- Residents and businesses along the proposal route – focussing on notifications and consultation regarding the detailed program of works and REF key findings and operational impacts.
- Council – focussing on a broad range of issues such as the urban amenity of the streetscape, and including consultation in accordance with the Infrastructure SEPP.

The tools and activities listed in Table 4.3 will be used to provide the community and stakeholders with a range of methods to find out more about the proposal and provide comment.

Table 4.3 Consultation activities during public display of the REF

Activity	Purpose and detail
Contact mechanisms	The community contact and feedback mechanisms listed in Table 4.2 will continue to operate throughout the display period. All details of community members and stakeholders who make contact with the proposal team, issues raised, and responses provided will be recorded in the consultation database.
Website	Information about the public display of the REF will be posted on the project website.
Letter to utility providers	A letter will be distributed to utility providers to provide them with information on the public display of the REF and invite submissions.
Letter to the Awabakal Local Aboriginal Land Council (LALC)	A letter will be issued to the LALC informing them of the preliminary findings of the due diligence assessment and seeking their involvement in further assessments.
Community information drop in sessions	Community information sessions will be held, staffed by project representatives from GHD and TfNSW, with representatives from UrbanGrowth NSW, Roads and Maritime and Council also invited to participate. The sessions will provide participants with an opportunity to speak with the proposal team, raise issues and concerns, ask questions, and provide feedback on the REF.
Advertisement	Advertisements will be placed in local newspapers to provide information about the display locations and information sessions.
Online advertisements	Online advertisements will be placed in the Newcastle Herald online to further promote the drop in sessions.

4.4.1 Submissions processing

Feedback received during the public display period will be treated as a submission and will be recorded on the consultation database. Submissions will be numbered and the details and key issues raised will be recorded in the database. A letter of acknowledgement will be sent to people/groups who make submissions to inform them about their submission number and where to find it in the submissions report. Submissions will not be responded to individually.

4.4.2 Submissions report

Following the REF display period, a submissions report will be prepared to:

- Summarise issues raised in submissions and respond to the issues raised.
- Provide any new information about the proposal in addition to that included in the REF.
- Identify any changes to the proposal and the potential impact of those changes.

TfNSW will consider the issues raised and the content of the submissions report as part of the determination of the proposal.

4.5 Post determination consultation

Should TfNSW proceed with the proposal, consultation with the community and key stakeholders would be ongoing in the lead up to, and during construction. The consultation activities would ensure that:

- The community and stakeholders have a high level of awareness of all processes and activities associated with the proposal.
- Accurate and accessible information is made available.
- A timely response is given to issues and concerns raised by the community.
- Feedback from the community is encouraged.
- Opportunities for input are provided.

The proposal information line and email address would continue to be available during construction, along with a 24 hour construction response line. Targeted consultation methods, such as letters, notifications, signage and face-to-face communications, would continue to occur. The website would also include updates on the progress of the proposal.

4.5.1 Consultation regarding active transport and urban amenity considerations

TfNSW will undertake ongoing consultation with Council, stakeholders and the community over the coming months to consider issues relating to active transport, parking and urban amenity. Working with UrbanGrowth NSW and Council, TfNSW will develop options for discussion as part of a more detailed consultation with community members. A detailed plan for this consultation process will be agreed with UrbanGrowth NSW and Council. Outcomes of this process will be addressed as part of a separate planning process following this consultation.

Part B

Concept design and development

5. Strategic context, need and design development

This chapter provides background information on the strategic context and need for the proposal, including an overview of the relevant strategic planning studies that have been undertaken. It also includes a description of the design development process and the design options considered.

5.1 Strategic planning and project need

5.1.1 Overview of project need

The Lower Hunter region is experiencing sustained population and economic growth, which in turn will drive growth in the Newcastle city centre and surrounding localities. The strategic planning that has been undertaken for Newcastle indicates that the city centre will have an additional 10,000 jobs and 6,000 homes by 2036 (NSW Planning and Environment, 2014). The NSW Government plans to transform and revitalise Newcastle's city centre over the next 25 years to accommodate these changes (Department of Planning and Infrastructure, 2012). This revitalisation aims to improve the economic performance of the city centre, consistent with Newcastle's place as NSW's second largest city, Australia's seventh largest city, and the capital of the Hunter Region.

The key issues and requirements for undertaking urban renewal in the Newcastle city centre have been considered by a number of planning studies and reports undertaken by the NSW Government and Council.

In December 2012 the NSW Government released the *Newcastle Urban Renewal Strategy* (Department of Planning and Infrastructure, 2012). The key issues identified by the strategy include:

- Newcastle lacks a centre that is capable of generating critical mass, catering for the higher order functions expected of a regional city.
- Physical barriers, including geographical constraints (mainly the heavy rail line) have caused the city centre to become elongated and poorly connected, especially to the waterfront.
- The physical and perceived barrier created by the heavy rail line impedes investment and growth, and prevents the centre from functioning in a cohesive manner.
- Existing transport access options are not conducive to servicing a vibrant, high-density city centre - currently only 13 per cent of peak hour trips to and from the Newcastle city are undertaken by public transport.

The *Newcastle Urban Renewal Strategy* detailed the priorities for renewing Newcastle's city centre. These priorities, which were reviewed and updated in 2014, include implementing the light rail system as one of the key transport related initiatives.

In July 2013 the NSW Government announced that train services along the Newcastle Branch Line would cease between Wickham and Newcastle stations, and that a new light rail line would be provided between Wickham and the Newcastle city centre.

The *Hunter Regional Transport Plan* (TfNSW, 2014b) was released in April 2014. Removing the heavy rail line between Wickham and Newcastle stations, developing a new transport interchange at Wickham, and a light rail system in the city centre are key actions presented by this plan.

The *Draft Plan for Growing Hunter City* (NSW Government, 2015) was released in November 2015. The draft plan states that the proposal '...will link the Wickham Transport Interchange with Pacific Park, activating Hunter and Scott Streets to support the broader vision for revitalising Newcastle City Centre.'

The proposal is required to proceed with the revitalisation program, and support development and urban renewal in the city centre, as outlined in the *Newcastle Urban Renewal Strategy*. The introduction of light rail will facilitate the revitalisation and redevelopment of the Newcastle city centre to boost economic activity and reinforce the city's role as a key regional centre in NSW. Light rail will support urban renewal, consolidation and development activity along the transport corridor.

5.1.2 Strategic context

The strategic context of the proposal is influenced by the outcomes of a number of strategic plans for transport, development and urban renewal that have been prepared at the state, regional and local levels.

In June 2012, the (then) NSW Minister for Planning and Infrastructure announced the creation of UrbanGrowth NSW, a government initiative to drive investment in key locations in NSW and help underpin the future prosperity of urban and regional centres. One of the priorities of UrbanGrowth NSW is to unlock private sector investment by coordinating and delivering lead-in infrastructure and services in development areas, and by planning and fast tracking urban renewal projects. UrbanGrowth NSW's portfolio of projects includes the NUTTP. The objectives of the NUTTP are listed in section 1.1.

The NUTTP includes the following priority projects:

- A transport interchange at Wickham.
- A light rail service between the Wickham interchange and Newcastle beach by way of the city centre.
- Use of rail corridor land for public domain purposes, connecting the city centre to the waterfront and supporting the development of the three city centre urban activation precincts.
- Redeveloping landholdings around Hunter Street Mall.

To implement the program, UrbanGrowth NSW is working closely with TfNSW, the Department of Planning and Environment, RMS, Hunter Development Corporation and Council. The first project, the Wickham Transport Interchange, received planning approval on 10 November 2014.

A description of the key strategic planning documents, and other relevant plans, policies and strategies, is provided by the strategic review included in Appendix A. Further information on the policies, plans and strategies that directly influenced the identification of options and the design of the proposal is provided in the *Newcastle Light Rail Options Identification and Initial Feasibility Assessment* report (GHD, 2014a).

5.2 Concept design development

5.2.1 Approach to the option development and design process

An iterative process of design development and evaluation has been undertaken to define the proposal. The design process has involved the following stages to date:

- Stage 1 – options identification and initial feasibility assessment (2013).
- Stage 2a – scoping design (early to mid 2014).
- Stage 2b – definition design (late 2014).
- Stage 2c – pre-concept design (2015).

The design of the preferred track alignment and other proposal features evolved over these stages as a result of engineering, traffic, financial, economic and environmental considerations. The option selection and design process has also taken into account issues raised during consultation with other NSW Government agencies, local government, the community and other stakeholders (refer to chapter 4).

The main assessments and studies undertaken during these stages are summarised below.

Newcastle Light Rail Options Identification and Initial Feasibility Assessment, GHD, February 2014

The key objectives of this assessment were to:

- Identify options for locating the heavy rail terminus and light rail interchange west of Stewart Avenue at Wickham.
- Develop all potential route options for the core light rail network east of Stewart Avenue to Newcastle Station.
- Determine a shortlist of preferred options for more detailed evaluation by assessing options against the strategic project objectives.
- Develop and assess potential options for a wider light rail network.
- Develop concepts to maximise efficiency and integration with the bus network by conducting an analysis of the preferred light rail route.

Preliminary Environmental Assessment Newcastle Light Rail Alignment Options, PB, March 2014

To inform the design process, the preliminary environmental assessment provided a high level assessment of the potential environmental issues associated with the three short-listed alignment options. It also provided recommendations for future, more detailed environmental assessment.

Newcastle Light Rail Draft Scoping Design Report, PB/Aurecon, May 2014

This report provides the outcomes of the scoping design stage for the proposal. It defines the preferred option to allow for an accurate and comprehensive business case cost estimate supported by a definitive design. The scoping design builds on the preliminary feasibility design for the proposal undertaken by GHD.

Newcastle Light Rail Product Definition Technical Report, GHD, May 2014

This report is the supporting technical report that accompanies the *Newcastle Light Rail Product Definition* report. Both were prepared to provide a more refined definition of the scope of work for the proposal. The report also provides the overarching design standards, guidelines and assumptions, and the functional and performance criteria for the proposal.

Newcastle Light Rail Draft Definition Design Report, PB/Aurecon, December 2014

This report, which described the definition design for the proposal, builds on the work undertaken in the scoping design stage. It defines the preferred alignment option to allow for an accurate and comprehensive business case cost estimate supported with a design for the proposal.

Newcastle Light Rail Draft Definition Design Report – Addendum 1: Emerging Opportunities, PB/Aurecon, December 2014

This report describes the supplementary work undertaken to support the definition design for the proposal. The report documents the emerging engineering opportunities that evolved from the Rapid Collaborative Design Review Process. This process involved extensive consultation with key stakeholders.

Newcastle Light Rail Pre-concept Design Report and Addendum, PB/Aurecon, June and October 2015

The pre-concept design report, which was completed in June 2015, describes the follow-on work undertaken to support the concept design for the proposal. It documents specific areas of the proposal where accelerated design development and investigation is needed to occur to build on the definition design. An addendum to the pre-concept design report was completed in October 2015.

5.2.2 Design principles and parameters

The following design criteria, constraints and assumptions were adopted for the definition and pre-concept design of the proposal (PB/Aurecon, 2014b and 2015a):

- Initial operating frequency will be 10 minutes between rail vehicles in each direction, with an increased frequency of service when practicable to best match peak period arrivals or departures at Wickham Transport Interchange.
- The stabling and maintenance facility needs to be large enough to allow maintenance of at least two vehicles at once and stabling of up to five vehicles.
- The maximum length of the light rail vehicles is nominally 30 metres.
- Stop platforms are to be designed to a maximum length of 33 metres with the opportunity to reduce the length during future stages of the design process.
- Priority for the operation of light rail vehicles can be achieved where required on the road network.
- The light rail vehicles will travel at speeds of up to 60 kilometres per hour in the former rail corridor, and at speeds of up to 40 kilometres per hour for in-street running. Lower speeds will be considered, where appropriate, in precincts where there is high pedestrian movements.
- The minimum width between a platform edge and any obstruction will be:
 - 4.4 metres (width of island platforms)
 - 2.7 metres (width at side platforms with an adjacent footpath)

- maximum longitudinal gradients of 2.5 per cent through platforms.
- Minimise modifications to existing track and/or road levels where practicable.

5.2.3 Option assessment process

In general, the option assessment process involved the following steps:

- Establish parameters, criteria and assumptions for option development.
- Confirm strategic objectives and assessment criteria through consultation with key stakeholders.
- Identify a long list of options.
- Assess options based on subjective scoring against assessment criteria and a sensitivity test.
- Identify a short list of options.
- Assess options using a multi-criteria analysis with evidence based scoring against assessment criteria.
- Identify the preferred option/s.

Stakeholder consultation was undertaken at key stages of the assessment process. This included workshops at the evaluation stages.

The first stage in the options assessment process, as summarised in the initial feasibility assessment report (GHD, 2014a), involved identifying options for the location of the:

- Heavy rail terminus – to determine the location for the Wickham Transport Interchange and the start of the light rail corridor.
- Light rail corridor between the Wickham Transport Interchange and the eastern end of the city centre.
- Light rail terminus (the end of the light rail corridor).

The preferred options identified by the feasibility assessment were further refined during the scoping design stage (PB/Aurecon, 2014a). Further information on the options for the location of the heavy rail terminus/Wickham Transport Interchange is provided in the *Wickham Transport Interchange Review of Environmental Factors* (GHD, 2014c).

5.2.4 Evaluation criteria

The assessment criteria applied to the agreed strategic project objectives (GHD, 2014a) are summarised in Table 5.1.

Table 5.1 Strategic objectives and assessment criteria

Strategic objective	Assessment criteria
Enabling urban revitalisation and connecting the foreshore with the city centre	<ul style="list-style-type: none"> • Land available for new development • Transit-oriented development potential
Supporting future strategic planning	<ul style="list-style-type: none"> • Alignment with the <i>Newcastle Urban Renewal Strategy</i> • Future proofing for extensions to the wider light rail network to the west • Supporting future heavy rail services
Maximising customer experience and safety	<ul style="list-style-type: none"> • Customer journey time including interchange requirements • Public transport integration between trains, light rail, buses and ferries • Impacts to customers during construction • Customer safety at stops and stations • Overall public transport patronage potential
Maximising transport network efficiency	<ul style="list-style-type: none"> • Traffic and bus network improvements with the removal of the railway level crossings • Bus network efficiency within the city centre • Operational efficiency for heavy rail stabling and maintenance facilities • Impacts on freight rail operations
Minimising construction and operational costs	<ul style="list-style-type: none"> • Indicative capital cost for the heavy rail terminus, light rail, and bus interchange • Property required outside of the railway corridor • Operating cost for train, light rail and bus services
Minimising delivery risk	<ul style="list-style-type: none"> • Engineering constructability • Required planning and environmental approvals

5.3 Route alignment options

5.3.1 Initial options

The list of options for the light rail corridor through the city centre consisted of eight options:

- Option 1 – Railway corridor from Stewart Avenue to Watt Street.
- Option 2 – Hunter Street connecting to Scott Street at Perkins Street.
- Option 3 – Hunter Street connecting to Hunter Street Mall at Perkins Street.
- Option 4 – King Street from Stewart Avenue to Watt Street connecting Marketown Shopping Centre and Civic Park.
- Option 5 – Honeysuckle Drive and Wharf Road along the harbour foreshore.
- Option 6 – Railway corridor connecting to Scott Street near Queens Wharf.
- Option 7 – Railway corridor connecting to Hunter Street Mall at Perkins Street.
- Option 8 – King Street, Darby Street, Hunter Street and Scott Street.

The options were assessed using assessment criteria listed in Table 5.1

5.3.2 Assessment

The feasibility assessment (GHD, 2014a) shortlisted the following corridor options:

- Options 1, 6 and 7 – located mainly within the former rail corridor.
- Options 2 and 3 – located mostly along Hunter Street.

Options 4 and 8 (via King Street), and option 5 (via Honeysuckle Drive and Wharf Road) were excluded because of:

- The potential for higher construction and operational costs.
- The number of tight turns which would increase journey times.
- Physical constraints such as steep grades on King Street east of Darby Street, and flood risks near Cottage Creek at the western end.
- Longer distances from Hunter Street.

5.3.3 Sub-options – location of the light rail terminus

Five sub-options for the terminus and the route to the terminus were identified and assessed, including:

- Two sub-options involved a terminus near Nobbys Beach, with routes for the light rail corridor via the former rail corridor and Wharf Road, or via Scott Street and Parnell Place.
- Two sub-options involved a terminus near Newcastle Beach, with routes for the corridor via Scott Street terminating in Zaara Street, or via Scott Street terminating adjacent to Pacific Park at Telford Street.
- One sub-option involved a terminus near Newcastle Beach, with a route for the corridor via Hunter Street, terminating in Pacific Park.

The sub-option along Scott Street terminating adjacent to Pacific Park was selected as the preferred sub-option. This option would provide convenient access to Pacific Park, Newcastle Beach, the Newcastle Beach pedestrian underpass, businesses and cafes in Scott Street, and residential areas in Newcastle East. This option would provide a suitable terminus location adjacent to Pacific Park, with good amenity for passengers and passive surveillance for passenger safety. The terminus would be located in an area proposed for high density residential development, and the development of new cafes and shops. This option would also be less costly to build and operate.

5.3.4 Shortlisted options

As an outcome of the above assessment, two options for the location of the light rail corridor were shortlisted:

- Option A involved locating the light rail corridor in the former rail corridor and Scott Street, terminating adjacent to Pacific Park.
- Option B involved locating the light rail corridor in Hunter Street and the Hunter Street Mall, terminating in Pacific Park.

Prior to the scoping design stage, a third 'hybrid' route option (option C) was developed involving a combination of options A and B. Option C involved locating the light rail corridor in the former rail corridor between Wickham Station and Worth Place. From Worth Place, the light rail corridor would be located in Hunter Street and Scott Street, and it would terminate adjacent to Pacific Park.

The three options, which are shown in Figure 5.1, were presented to the community in February and March 2014.

5.3.5 Assessment of shortlisted options

An assessment of the three shortlisted alignment options was undertaken as part of the scoping study (PB/Aurecon, 2014a) using a multi-criteria assessment and the criteria provided in Table 5.1. The report concluded that all options:

- appeared to be technically feasible based on available information
- broadly complied with the preliminary functional and design requirements
- were similar in design and construction complexity.

The report concluded that the preferred option would need to be identified in terms of its consistency with the objectives and desired outcomes of the *Newcastle Urban Renewal Strategy* and the NUTTP.

The three shortlisted options were considered further by stakeholder agencies. Three variations of option C were also considered as part of the assessment process.

5.3.6 Preferred alignment option

Following further consideration by the project team, option C (the hybrid option) was selected as the preferred option. This option combines the benefits of the options that were initially identified (options A and B) by using the existing rail corridor and servicing the city centre, while avoiding impacts on Hunter Street Mall and Pacific Park. Option C was selected as the preferred option because it:

- Supports the Newcastle Urban Renewal Strategy by connecting people to activity zones in the city centre as well as boosting activity on Hunter Street and Hunter Street Mall.
- Allows for the realisation of urban renewal and transformation opportunities in the former rail corridor, together with key public domain upgrades, to improve north–south connectivity across the corridor.
- Would enable customers to exit the light rail directly onto Hunter Street, providing ready access to businesses and other services along and surrounding the street.
- Enables the light rail to pass directly through the civic precinct.
- Encourages people to use public transport in the Newcastle city centre.
- Connects people directly to retail zones, including Hunter Street Mall.

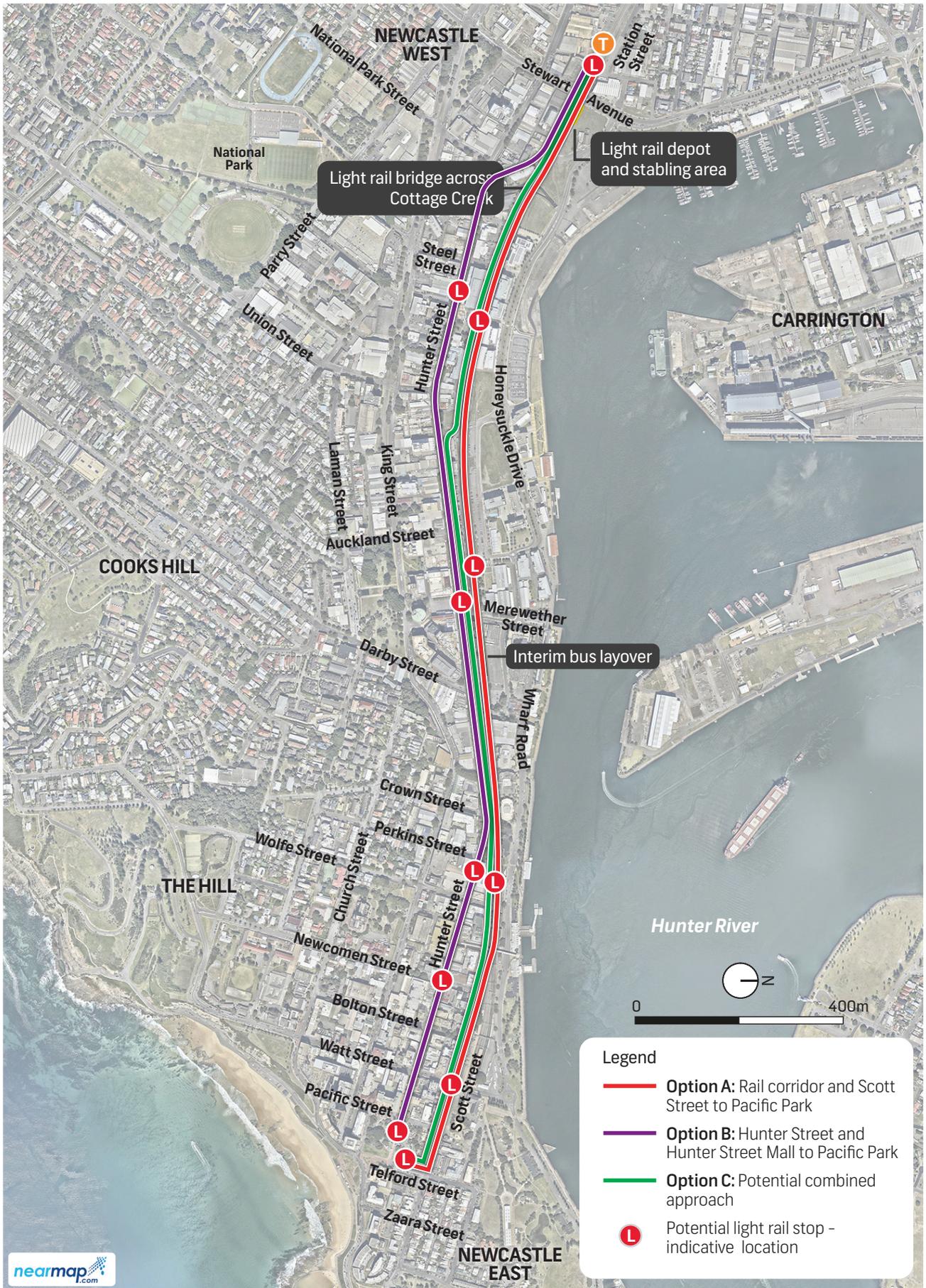


Figure 5.1 Light rail corridor options

5.4 Light rail stop options

5.4.1 Initial options

Options

For each route option, an initial list of six general light rail stop precincts was identified by the feasibility study (GHD, 2014a). The precincts were spaced about 600 metres apart. The proposed locations of these precincts for each route option were:

- Wickham, west of Stewart Avenue at the terminus station and interchange.
- Honeysuckle, to service the Honeysuckle and Marketown Shopping Centre precincts.
- Civic, near Civic Station and Wheeler Place.
- Queens Wharf, near the ferry terminal or at the western end of the Hunter Street Mall.
- Newcastle Station, near Watt Street or at the eastern end of the Hunter Street.
- Pacific Park with access to the beach.

A total of 28 potential light rail stop locations were identified and assessed for the six stop precincts.

Assessment

For each light rail corridor option, the product definition technical study (GHD, 2014b) assessed the potential light rail stop locations at each stop precinct. The key attributes considered in the assessment of the route and stop locations were:

- alignment as level and straight as possible
- current and future land use close to the stop
- customer generators and attractors
- interfaces with the road network and other road users
- access to properties, including driveways and loading zones
- underground utilities, services and mine subsidence risks
- flooding and drainage risks
- integration with the pedestrian network.

Five criteria and ten sub-criteria were developed to assess the light rail stops to support the strategic objectives of:

- maximising customer experience
- maximising network connectivity
- minimising infrastructure cost and impacts
- enabling urban revitalisation.

These criteria were used to assess and score the stop location options within each of the six stop precinct areas. As a result of this analysis, 12 light rail stop locations were short-listed for further detailed assessment. The *Scoping Design Report* (PB/Aurecon, 2014a) involved a comparative analysis of the shortlisted options against the identified urban design principles.

Since the *Scoping Design Report* was issued in May 2014 (PB/Aurecon, 2014a), stop locations and arrangements were further developed, with input from UrbanGrowth NSW, Council, Roads and Maritime, and TfNSW. More detailed rail alignments and road alignments were developed, and a number of option studies were carried out for the proposed stop locations. The stop options listed in Table 5.2 were adopted by the *Definition Design Report* (PB/Aurecon, 2014b).

Table 5.2 Definition design stop options (December 2014)

Stop precinct	Preferred stop location and configuration
Wickham Transport Interchange	Single side platform to west of Stewart Avenue – turnback in front of the stabling and maintenance facility (east of Stewart Ave)
Honeysuckle	Island platform in rail corridor to east of Hunter Street to Honeysuckle pedestrian axis through route
Civic	Island platform east of Auckland Street
Darby Street	Split side platforms – eastbound to east of Darby Street and westbound to west of Darby Street
Perkins Street	Parallel side platforms to east of Perkins Street – eastbound platform side island, westbound side platform integrated with footpath
Newcomen Street	Parallel side platforms to east of Newcomen Street integrated with footpath
Pacific Park	Single side platform on Scott Street

5.4.2 Preferred option

During ongoing stakeholder engagement and consultation, Council proposed some changes to the configuration of light rail stops from those stops proposed in the *Definition Design Report*. The design reviewed and evaluated the proposed changes and made the following changes:

- Honeysuckle stop, changed to side platforms
- Darby Street stop, removed
- Perkins Street stop, removed
- new island stop at Crown Street
- Newcomen Street stop, removed
- new island stop at Market Street.

The proposal includes six light rail stops at the following locations:

- Wickham Transport Interchange
- Honeysuckle
- Civic
- Crown Street
- Market Street
- Pacific Park.

5.5 Other options investigated

Other options for key infrastructure considered during design development are summarised below.

5.5.1 Location of the stabling and maintenance facility

The scoping design stage involved determining a location for a facility to stable and maintain the light rail vehicles.

Options and assessment

A series of workshops were held to explore potential locations for the facility along the length of the proposal site. A multi-criteria assessment was used to determine the most suitable site location. Two preferred locations were identified:

- At the location of Wickham Station – three potential locations/configurations were considered.
- At the location of Newcastle Station – three potential locations/configurations were considered.

Preferred option

Locating the facility on a site at the existing location of Wickham Station was identified as the preferred option, based on functional, project cost and land use considerations. It would avoid impacts to the State heritage listed Newcastle Station, and provide opportunities for the adaptive re-use of Newcastle Station and surrounding land.

5.5.2 Mixed vs separated running

The three types of light rail operation with respect to the road network and integration with general road traffic are:

1. Segregated running – the light rail alignment is located in its own corridor separate from the road corridor.
2. Separated running – the light rail alignment is located within the road corridor in a dedicated lane which is not generally used (except for crossing purposes) by general road traffic.
3. Mixed running – the light rail alignment is located within the road corridor in a lane which is also used by general road traffic.

Options

The alignment options proposed as an outcome of the definition design were:

- Segregated running in the former rail corridor (between the Wickham Transport Interchange and Worth Place).
- Separated or mixed running in Hunter Street and Beresford Street.
- Mixed running in Scott Street (as Scott Street is relatively narrow, mixed running is the only feasible option).

Assessment

Assessing the preferred running option for Hunter Street involved (PB/Aurecon, 2014c):

- Task 1 – confirming operational requirements.
- Task 2 – agreeing on evaluation criteria.
- Task 3 – assessing the options against the criteria using a multi-criteria analysis.
- Task 4 – identify the preferred option.

The following list of criteria were agreed and adopted:

- operation transit time
- operation reliability
- safety
- road traffic operations
- road footprint
- visual impact
- public amenity
- stop typology
- pedestrian access
- environmental impacts
- future proofing
- cost.

Preferred option

Separated running was selected as the preferred option for Hunter Street for the following reasons:

- As Hunter Street is busier than Scott Street, separated running would reduce the potential for safety risks compared with mixed running, by minimising the number of interactions between light rail vehicles and other road and pedestrian traffic.
- It would eliminate, to the maximum extent possible, the potential for obstructions crossing or blocking the path of light rail vehicles and potentially interfering with the operation of the proposal. This would enable the proposal to achieve the required service frequencies and allow integration with the arrival/departure of heavy rail services at the Wickham Transport Interchange.
- It would minimise the potential loss of on-street parking – parking adjacent to mixed running can contribute to safety risks, particularly for pedestrians. Using separated running means that less parking spaces would be impacted.

5.5.3 Overhead wiring

Options and assessment

The following options were considered during the scoping design phase:

Overhead wiring system options

- Bridle wire system (contact only system), consisting of a single or twin contact wire (depending on electrical demand requirements) supported using bridle wires at supports.
- Catenary system (contact and catenary system), consisting of two wires at different vertical levels, with the contact wire supported by a catenary wire, with droppers spaced at appropriate distances along the length.
- Catenary with sections of bridle wire (mixed option).
- Wire free running, which uses electricity provided by a ground level power supply and electromagnetic induction.

Tensioning arrangements

- Regulated system (balance weights), using stacks of weights at each end of the wire with a fixed point in the middle to ensure the wire tension remains as close to constant as possible as the temperature changes.
- Regulated system (non-balance weights), using alternative tensioning arrangements such as spring tensioning, hydraulic or pneumatic devices.
- Fixed system (fixed anchors at either end), using a fixed tension system where the wire is fixed at a nominal tension at each end.

Overhead wiring structure options

- Cantilever on poles, using masts placed between tracks or to one side, which would support wires for each track using cantilever arrangements to reduce the number of footings and provide independent wiring systems for each track.
- Span wire arrangements (supported from poles), involves stringing wires between two structures that support and register the contact and catenary (if applicable) wires, allowing the structures to be placed further apart.
- Span wire arrangements (supported from surrounding buildings), using surrounding buildings to support the span wires.
- Spider web pull off arrangements, used on tight corners where providing poles at the required spacing would not be practical, and involves providing a number of wires from the same pole structure.
- Reduced contact wire height in areas of segregated running.

Preferred option

The preferred option for the overhead wiring system was the bridle wire system. The proposal involves a short, relatively simple light rail system with no specific material or technical gains to justify the higher cost and complexity associated with wire free technology. A bridle wire option would minimise the potential visual impacts compared with other wired options.

The preferred tensioning arrangement was the regulated system (balance weights). This option was selected as there are no major issues with space which would justify the additional time and cost of implementing alternative options.

The preferred option for overhead wiring structures was cantilever on poles. This option, with a maximum structure spacing of 35 m, was preferred and selected to provide independent wiring systems for each track. This option is shown in Figure 6.5.

6. Description of the proposal features and operation

This chapter provides a description of the proposal's features and operation for the purposes of the REF. It includes a description of the infrastructure proposed, and how the proposal would operate. The scope of the proposal described in this section is indicative and is based on the design information available at the time the REF was prepared.

6.1 Overview of the proposal

6.1.1 Proposal objectives

As noted in chapters 1 and 5, the proposal involves constructing and operating the light rail element of the NUTTP. The NUTTP is underpinned by the following objectives:

- Bring people back to the city centre.
- Reconnect the city to its waterfront.
- Help grow new jobs in the city centre.
- Create great places linked to new transport.
- Create economically sustainable public domain and community assets.
- Preserve and enhance the city centre's heritage and culture.

The objectives of the proposal are to:

- Enhance the liveability of Newcastle by improving accessibility and amenity along the route.
- Reconnect the city centre to the foreshore.
- Encourage urban transformation, including higher density, mixed use office, residential and commercial projects, within the city centre and along the route.
- Promote a higher mode share for public transport with commuters to the city centre using the bus or train services to connect to the light rail at Wickham.
- Provide an alternative mode of travel for short trips within the city centre.
- Reduce traffic in the city centre and improve pedestrian and cyclist amenity by discouraging car parking demand within the city centre in consultation with Council.

6.1.2 Key features of the proposal

The key features of the proposal are summarised below and are shown in Figure 6.1 to Figure 6.4.

Light rail infrastructure

- About 2.7 kilometres of light rail track, consisting of about 2.5 kilometres of dual track and 180 metres of single track.
- Six light rail stops and associated infrastructure (such as platforms, shelters and lighting):
 - Wickham Interchange
 - Honeysuckle

- Civic
- Crown Street
- Market Street
- Pacific Park.
- A light rail stabling and maintenance facility at the location of the existing Wickham Station.
- Terminus facilities near the Pacific Park stop.
- Ancillary infrastructure, including two new substations, power supply, wiring and utilities.

Former rail corridor works

- Remove the existing Wickham Station buildings, platforms and pedestrian bridge.
- Remove the pedestrian bridge located over the former rail corridor to the west of Market Street.

Transport network works

Bus network

- Remove seven existing bus stops along Hunter and Scott streets and provide four new stops in Watt Street, Wharf Road (two stops) and Centenary Road.

Road network and intersection changes

- Changes to the road configuration along the light rail corridor to accommodate the light rail infrastructure on Beresford, Hunter and Scott streets.
- Changes to the following intersections along the light rail corridor:
 - Stewart Avenue/Beresford Street
 - Steel Street at the former rail corridor
 - Hunter Street/Worth Place
- New signalised pedestrian crossings to provide access to light rail stops at:
 - Hunter Street near Crown Street
 - Scott Street near Market Street.
- New signalised road crossings of the former rail corridor at:
 - Steel Street
 - Worth Place.
- Changes to the road configuration outside the light rail corridor at the following locations:
 - Honeysuckle Drive westbound at Hannell Street
 - King Street between Union Street and Darby Street (provide peak period no stopping zone)
 - King Street/Darby Street intersection, northbound on Darby Street
 - King Street/Darby Street intersection, southbound on Darby Street.

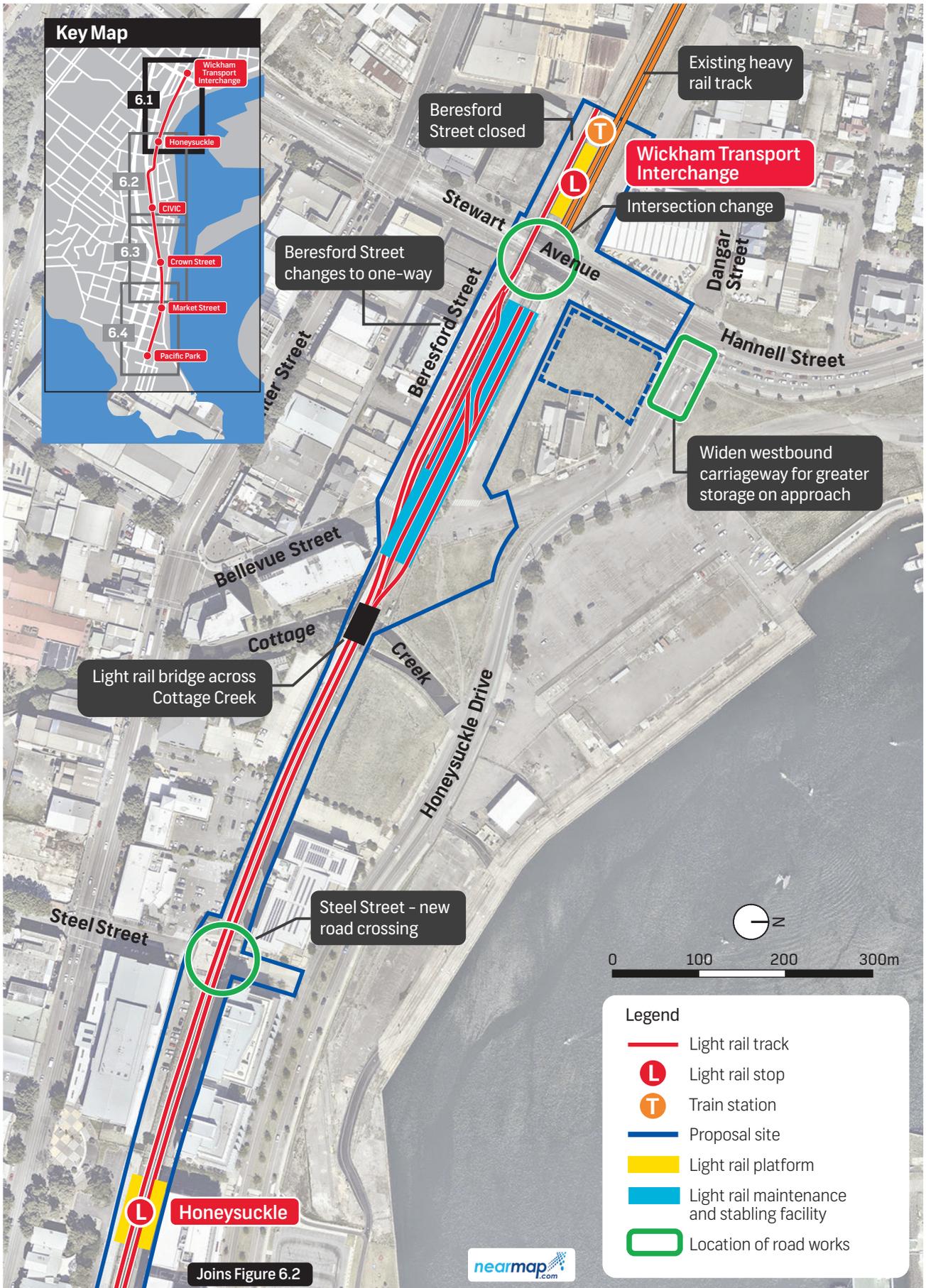


Figure 6.1 Key features of the proposal (section 1)

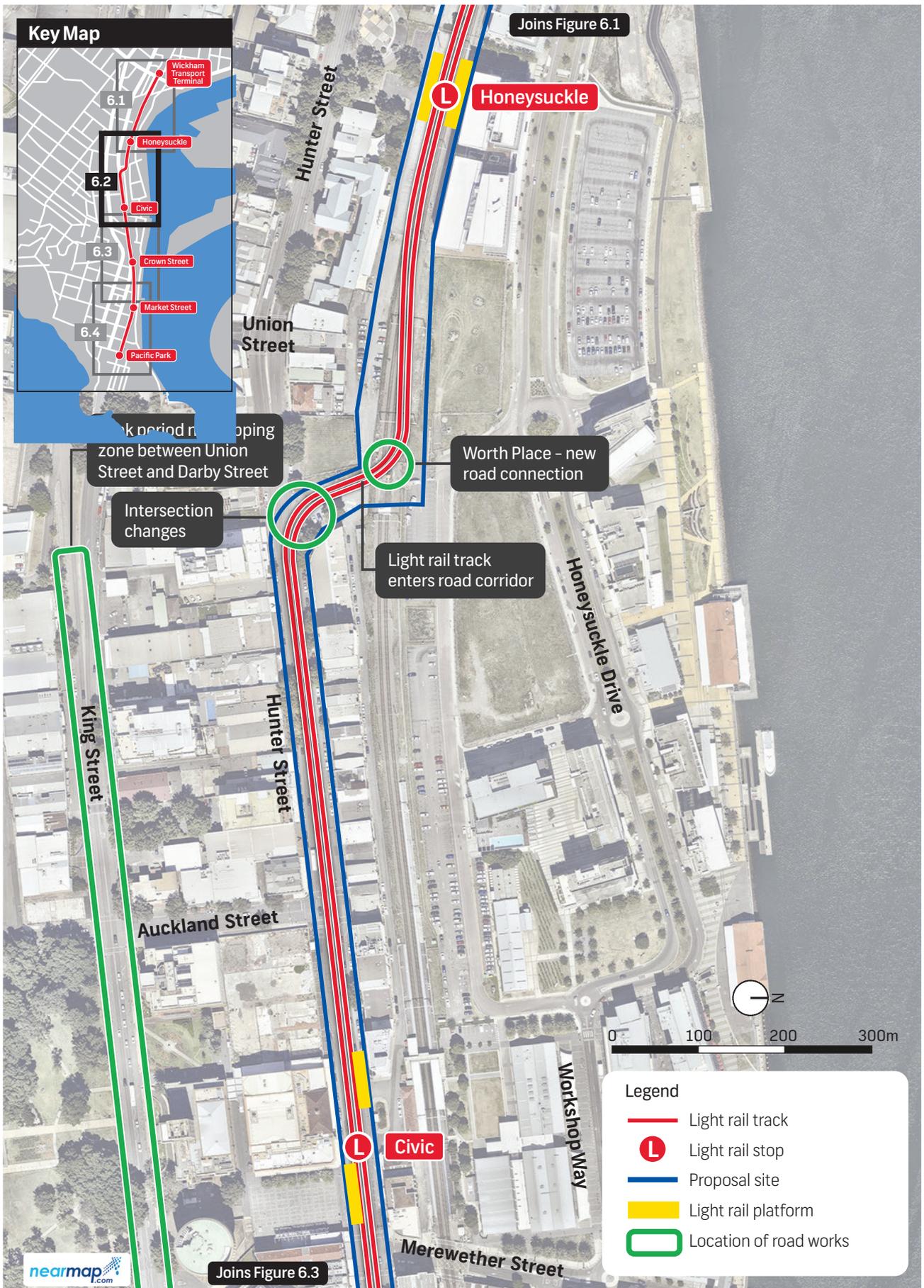


Figure 6.2 Key features of the proposal (section 2)

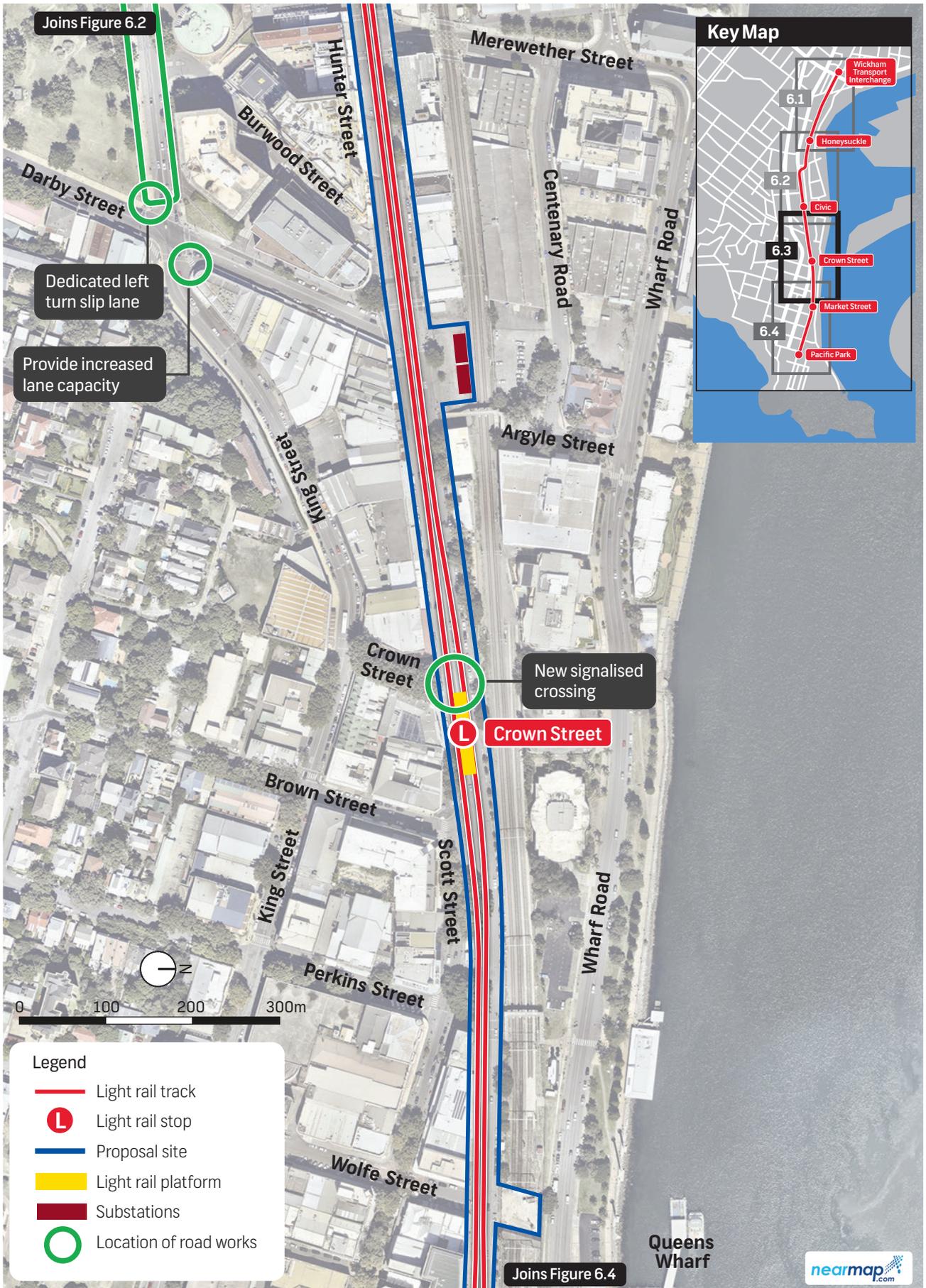


Figure 6.3 Key features of the proposal (section 3)

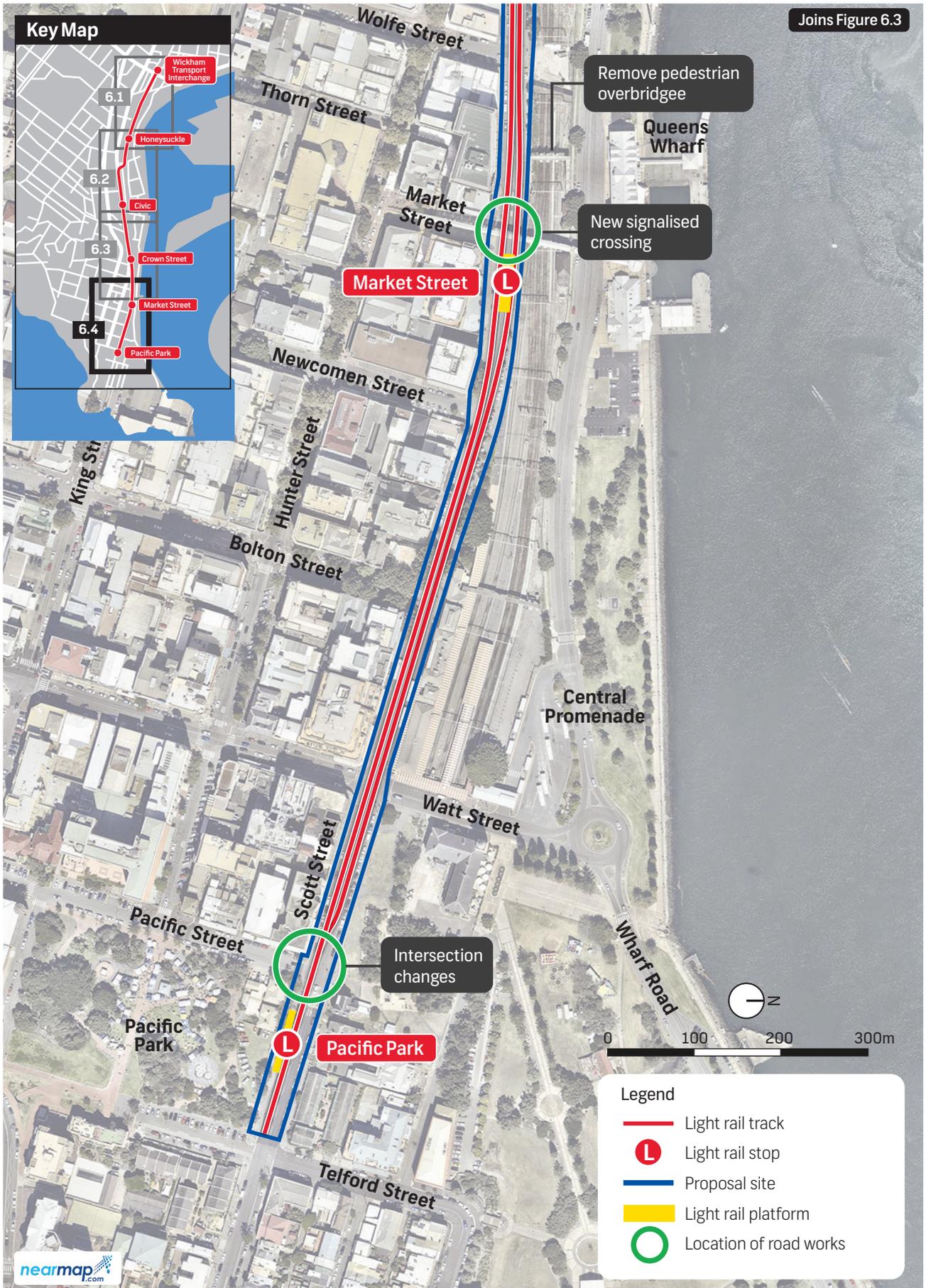


Figure 6.4 Key features of the proposal (section 4)

Operation of the proposal

- Mix of segregated, separated and mixed running.
- Light rail services would commence at 5am and finish at 1am.
- Between the core hours of 7am and 7pm, services would operate every 10 minutes on weekdays and every 15 minutes on weekends.
- Less frequent services would be provided in the early morning, evening and night periods.
- Five light rail vehicles would operate with capacity for a minimum of 100 passengers per vehicle.

6.1.3 Description of the proposed light rail route

Between the Wickham Transport interchange and Worth Place, the light rail route would be located within Beresford Street and the former rail corridor. From Worth Place to the terminus at Pacific Park, the light rail route would be located within Hunter Street and Scott Street. The proposed route is described below from west to east.

From the Wickham Transport Interchange to Worth Place

The route would start as a single track section immediately south of the Wickham Transport Interchange on Beresford Street to the west of Stewart Avenue. It would travel east along the northern side of Beresford Street, just to the south of the former rail corridor, with a signalised crossing of Stewart Avenue. The dual track section would start just to the east of Stewart Avenue.

The route would enter the former rail corridor just to the east of the existing Wickham Station buildings. It would travel within the former rail corridor to Worth Place. A new road crossing for Steel Street would be provided. At Worth Place, the route would leave the former rail corridor and enter Hunter Street at a proposed new road intersection.

Along Hunter Street

The route would then continue along Hunter Street, through the intersections at Auckland Street, Merewether Street and Darby Street. The light rail corridor would be separated from adjacent road traffic along Hunter Street, only interfacing with road vehicles at signalised road intersections.

Along Scott Street to the terminus at Pacific Park

At the intersection between Hunter Street and Scott Street, the route would leave Hunter Street and travel east along Scott Street. The route would travel through the intersections at Wolfe Street, Market Street, Newcomen Street, Bolton Street, Watt Street and Pacific Street. Between Newcomen Street and Pacific Street, the light rail corridor would operate with road traffic in a shared running arrangement.

At the intersection of Scott Street and Pacific Street, traffic signals are proposed to segregate the eastbound track from road vehicles. This would allow the two tracks to form a single track on Scott Street adjacent to Pacific Park.

The route would then end at the light rail terminus, located just to the east of the Pacific Park stop, on the southern side of Scott Street adjacent to the northern side of Pacific Park. A small section of single track long enough to hold a single light rail vehicle would be provided between the Pacific Park stop and the buffer stop at the end of the light rail track.

6.2 Light rail infrastructure

6.2.1 Track alignment and layout

Horizontal alignment

The proposal consists of about 2.7 kilometres of light rail track, consisting of about 2.5 kilometres of dual track and 180 metres of single track. As noted in section 5.5.2, the proposal would involve three different running types, depending on location:

- **Segregated running** (the light rail alignment is located in its own corridor completely separate from the road corridor) - in the former rail corridor where there is no interaction between the light rail corridor and road traffic other than at designated intersections (a distance of about 600 metres).
- **Separated running** (the light rail alignment is located within the road corridor in a dedicated lane which is not generally used (except for crossing purposes) by general road traffic):
 - From the Wickham Transport Interchange along Beresford Street to the former rail corridor, where the light rail corridor would run along the northern lane adjacent to a one-way traffic lane (about 280 metres).
 - Along Hunter Street between Worth Place and Scott Street, where the light rail corridor would run along two lanes adjacent to traffic lanes (about 1,300 metres).
- **Mixed running** (the light rail alignment is located within the road corridor in a lane which is also used by general road traffic) - along Scott Street to Pacific Park (about 500 metres).

The horizontal alignment is shown in Figure 6.1 to Figure 6.4. Typical cross sections of each type of alignment configuration are shown in Figure 6.5 to Figure 6.7.

Vertical alignment

The light rail corridor would typically be located at-grade along the former rail corridor and existing roads. The steepest section would be located along Scott Street to Pacific Park. Further work would be undertaken during the detailed design stage to match the track alignment with an acceptable road surface and minimise the amount of road resurfacing works required.

Turnouts

The proposal includes two turnout points (a junction point where a light rail vehicle could change between two routes/travel directions). One would be located at Beresford Street to allow light rail vehicles to enter/exit the single track section adjacent to the Wickham Transport Interchange. The other would be located east of the intersection between Scott Street and Pacific Street to allow light rail vehicles to enter/exit the single track section into the Pacific Park stop.

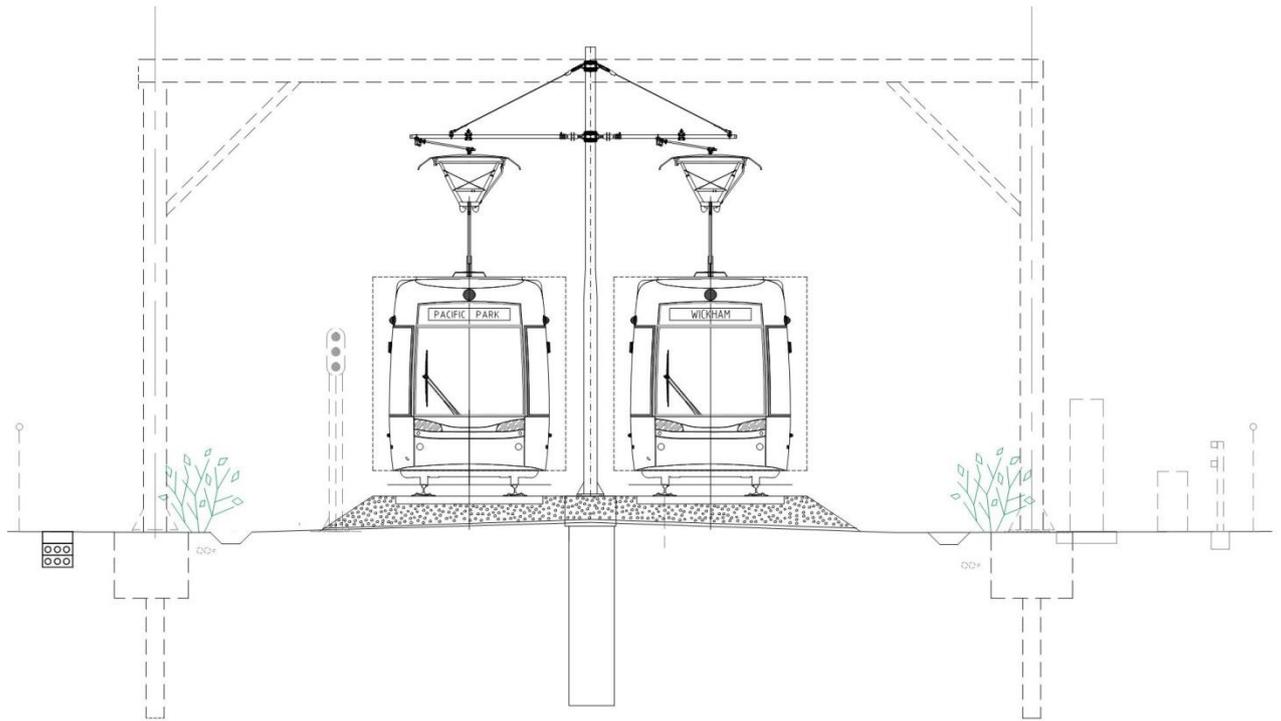


Figure 6.5 Typical cross sections along the former rail corridor

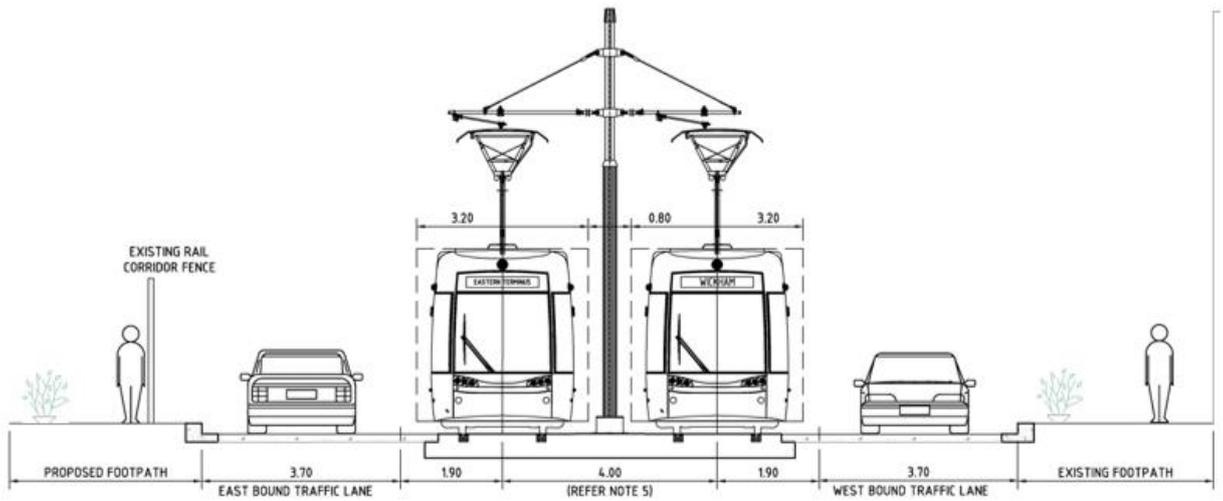


Figure 6.6 Typical cross section along Hunter Street – at Crown Street

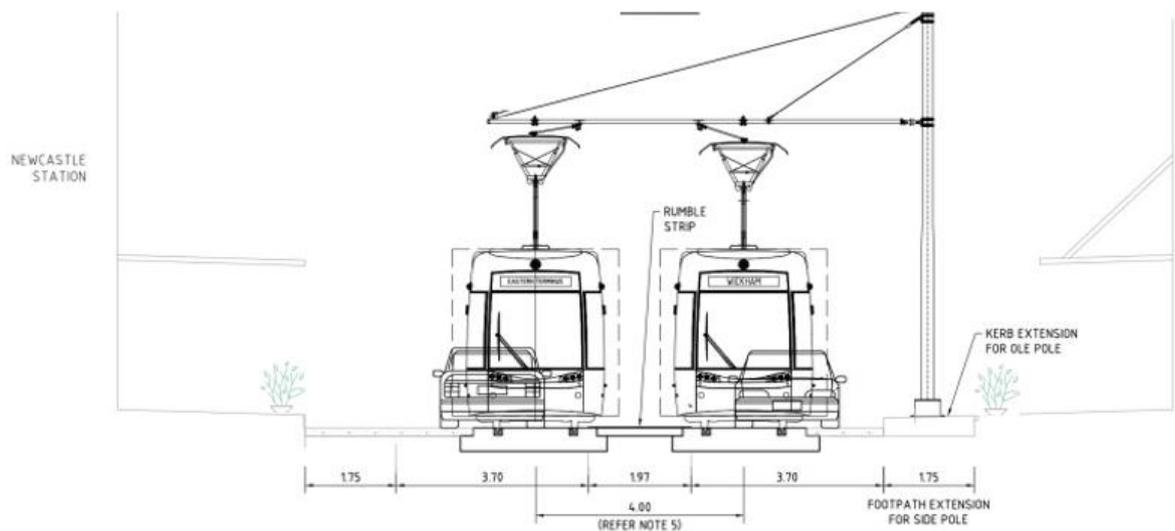


Figure 6.7 Typical cross section along Scott Street near Newcastle Station (mixed running)

6.2.2 Track materials

The materials used to construct the track vary, depending on the different areas that make up the light rail corridor.

Within the former rail corridor

The light rail tracks would be set on ballast. The following finishes are proposed:

- The existing heavy rail track ballast would be re-used where practicable.
- Low height landscaping would be used to define the edges of the corridor.
- A hedge or low fence would be placed between the landscaping and ballast edge to reduce the risk of people crossing the tracks other than at designated crossing locations, with allowance made for safe emergency egress.

Within the road corridor

The tracks would be set in concrete slabs within the road corridor. Surface finishes would depend on the form of running. The following finishes are proposed:

- Concrete track slab as a surface finish where the light rail corridor is in separated running (in Hunter Street).
- Concrete track slab with a top layer of asphalt where the light rail corridor is in shared running (in Scott Street).

6.2.3 Light rail stops

Stop locations and descriptions

Six light rail stops would be provided as part of the proposal. The proposed light rail stops are listed in Table 6.1. The spacing of the stops ranges from about 400 to 650 metres between stops. The stop names are indicative only at this stage. Final names would be determined in consultation with the Geographical Names Board of NSW.

The proposed layout at stops is shown in Figure 6.8 to Figure 6.13. Indicative cross sections are provided in Figure 6.14 to Figure 6.17.

Table 6.1 Proposed light rail stops

Stop	Type of stop	Location of stop	Pedestrian access to stop
Wickham Interchange	Single side platform	Located on the northern side of Beresford Street on the southern side of the Wickham Transport Interchange.	Footpath access from Stewart Avenue
Honeysuckle	Two side platforms	Located within the former rail corridor on either side of the two tracks, to the east of the pedestrian crossing at Kuwumi Place.	From the Kuwumi Place pedestrian crossing
Civic	Staggered stops on either side of Hunter Street	Located on either side of the two tracks in Hunter Street, east of Auckland Street. Located to the north of the Newcastle University CBD campus.	Signalised pedestrian crossing in between the two staggered platforms
Crown Street	Single island platform	Located between the two tracks within Hunter Street, to the east of Crown Street.	Signalised pedestrian crossing at the western end of the platform
Market Street	Single island platform	Located between the two tracks within Scott Street, to the east of Market Street.	Signalised pedestrian crossing at the western end of the platform
Pacific Park	Single side platform	Located on the southern side of the single track section in Scott Street, on the southern side of the street, adjacent to Pacific Park.	Footpath access from Scott Street at Pacific Street with a new traffic signal at Pacific Park

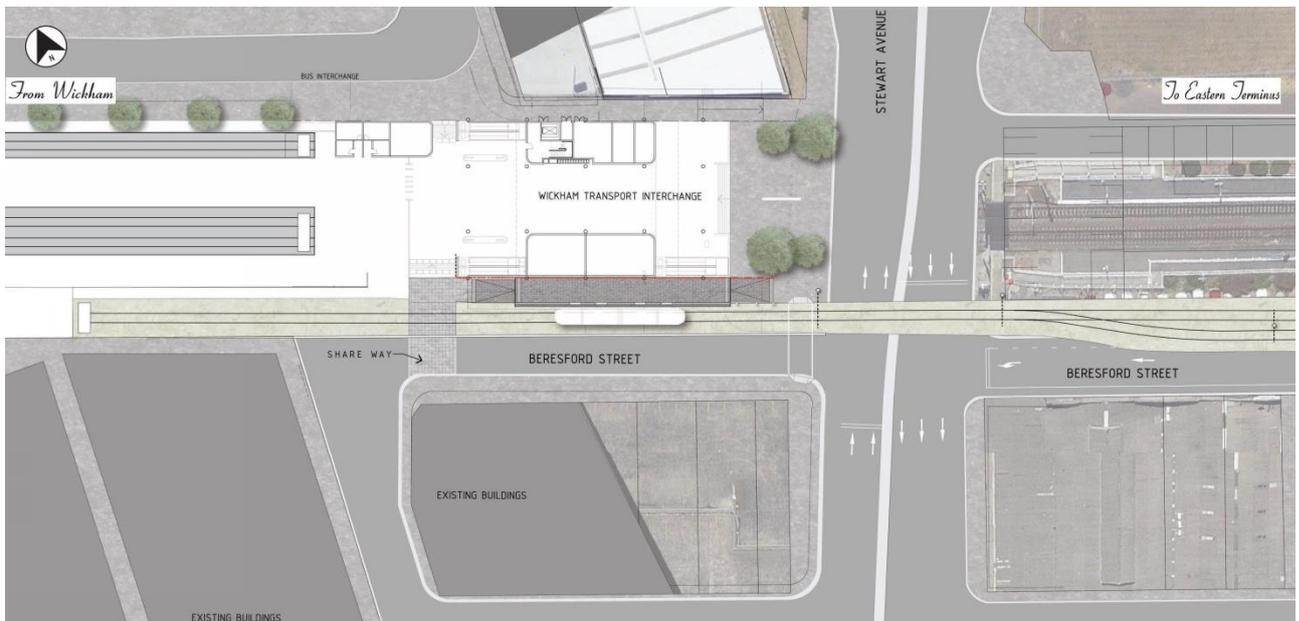


Figure 6.8 Wickham Interchange stop – indicative aerial view



Figure 6.9 Honeysuckle stop – indicative aerial view



Figure 6.10 Civic stop – indicative aerial view

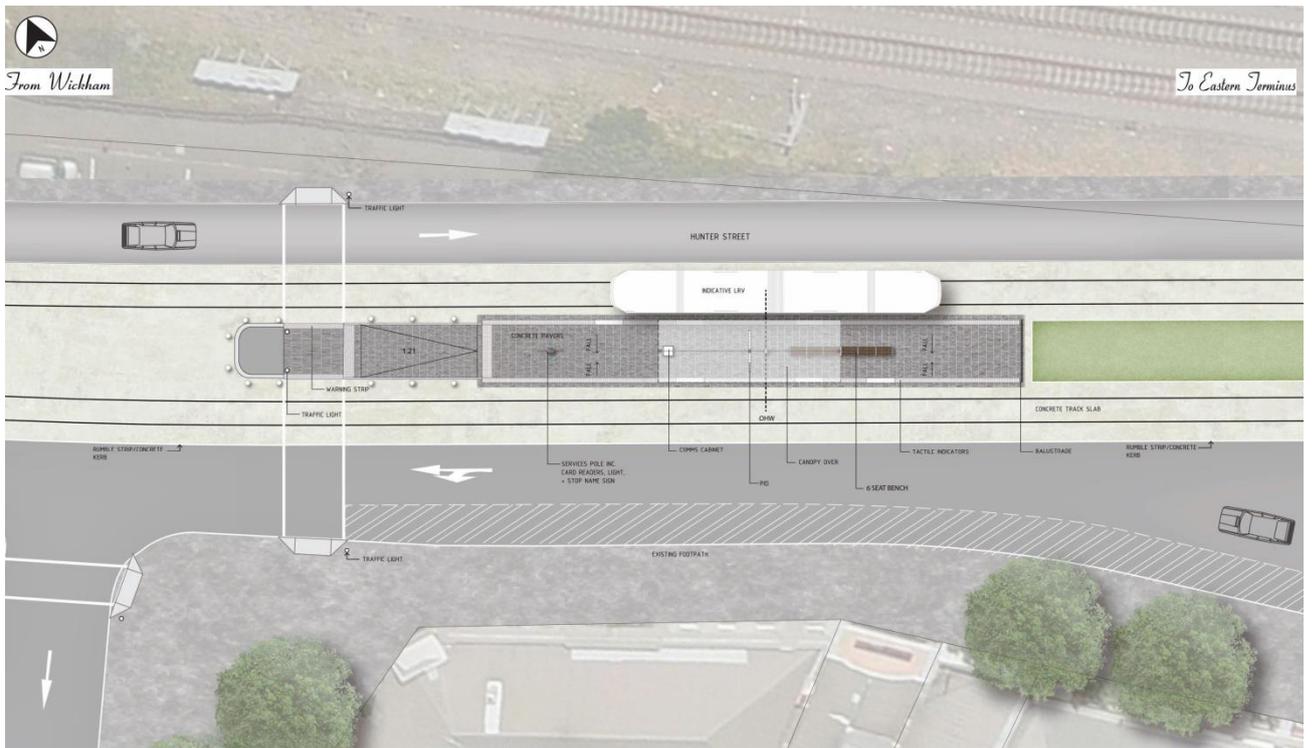


Figure 6.11 Crown Street stop – indicative aerial view



Figure 6.12 Market Street stop – indicative aerial view

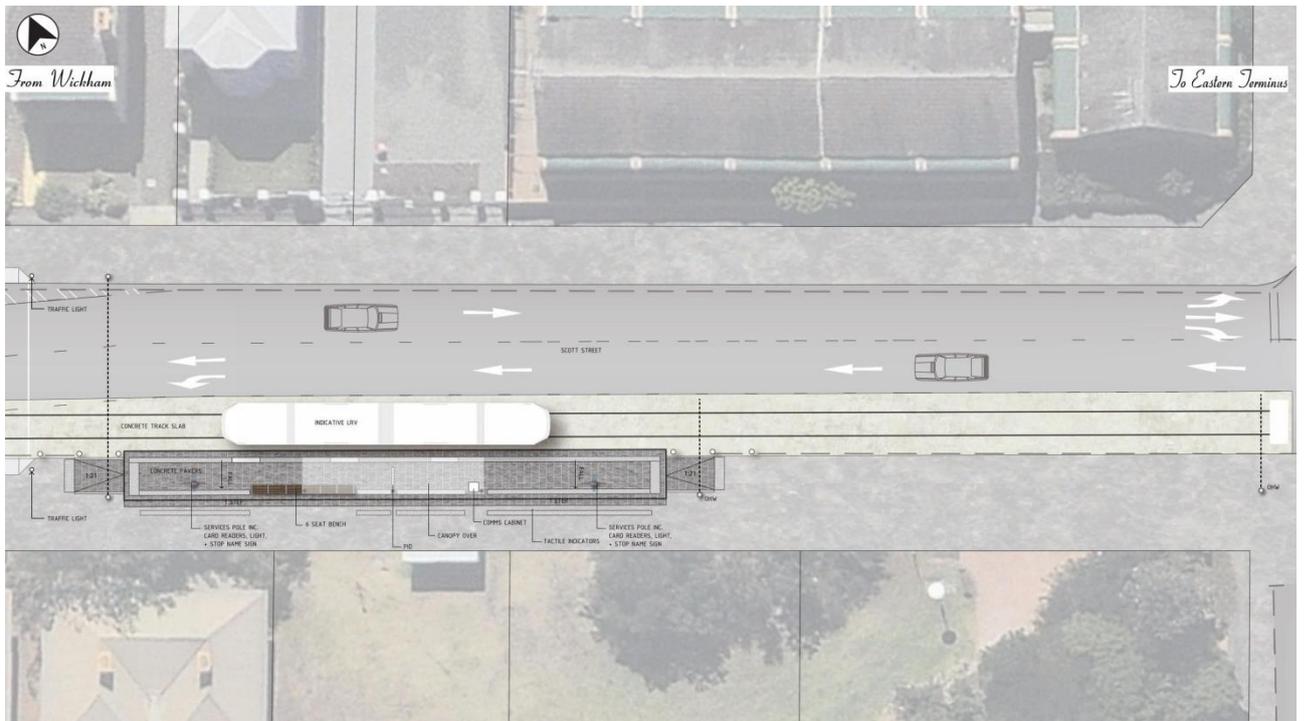


Figure 6.13 Pacific Park stop – indicative aerial view

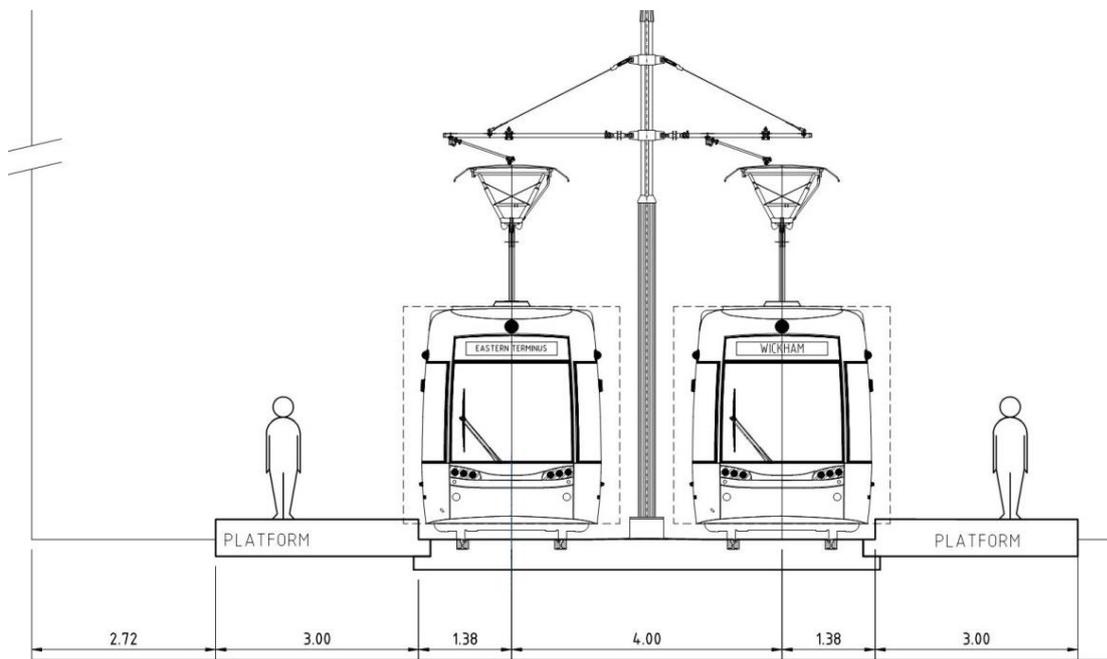


Figure 6.14 Honeysuckle stop – indicative cross section

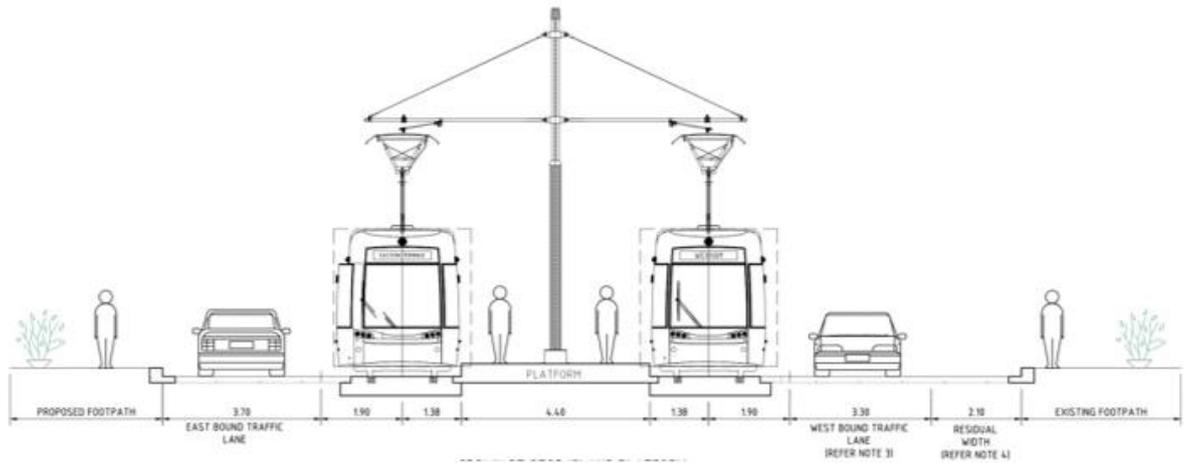


Figure 6.15 Crown Street stop – indicative cross section

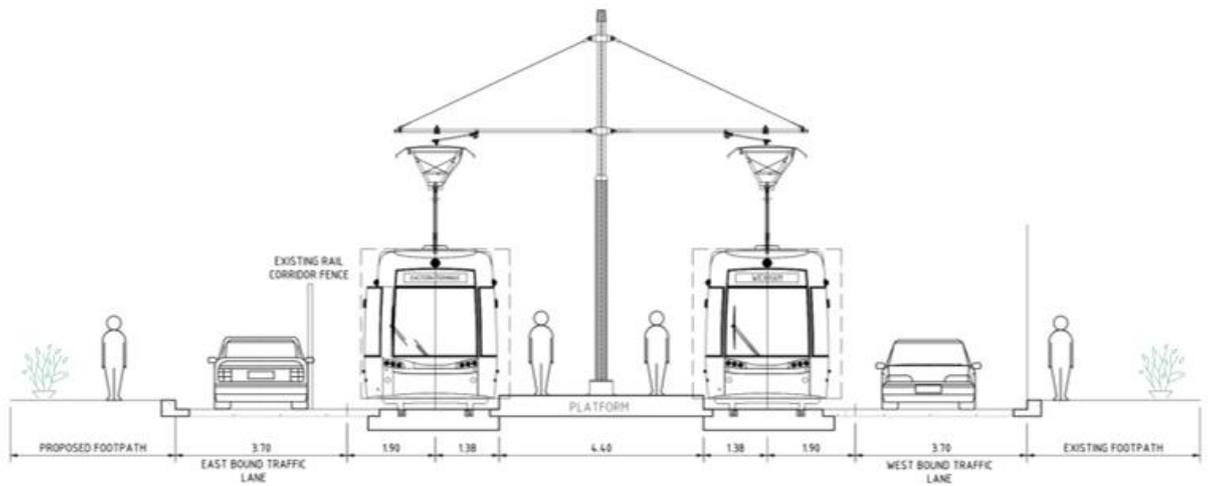


Figure 6.16 Market Street stop – indicative cross section

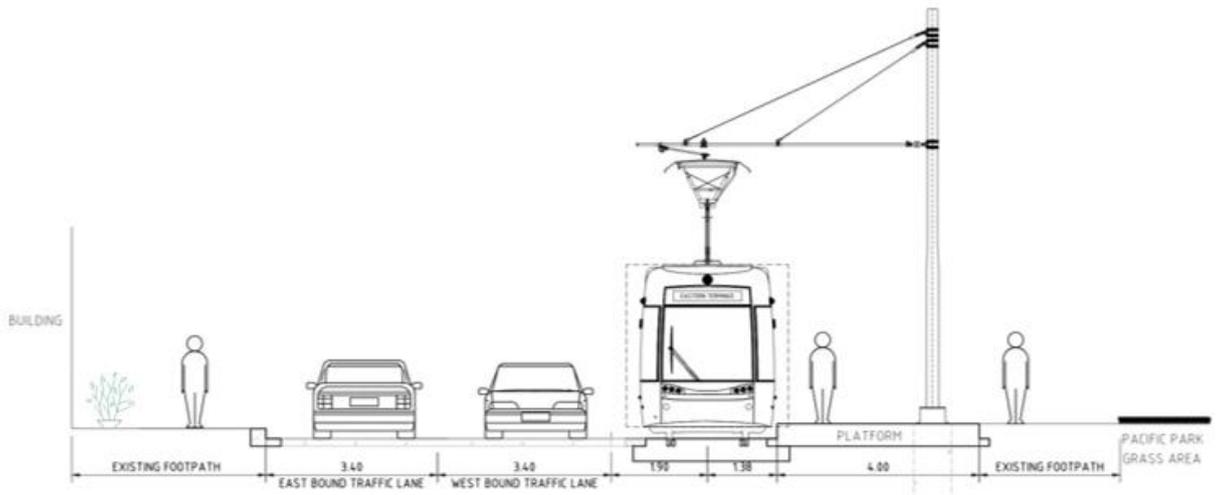


Figure 6.17 Pacific Park stop – indicative cross section

Stop design features

The stops would include finished concrete platforms with the following dimensions:

- Length nominally 33 metres to suit light rail vehicles.
- Widths varying from 2.9 to 4.4 metres depending on the type of platform.
- Height of about 300 millimetres above the track level.

At each end of the platforms there would be ramps about six metres in length down to ground level. Other features that may be located at the stops include:

- signage, including dynamic and static passenger information
- a control cabinet with a height of about 1.5 metres, and a width and depth around 0.4 by 1 metre
- handrails
- canopies to provide shade/weather protection
- provision for the future installation of Opal card top up machines and/or ticket vending machines
- closed circuit television (CCTV)
- a 'help point' integrated with other platform based services and the operations centre
- bins
- seating.

6.2.4 Light rail stabling and maintenance facility

A light rail stabling and maintenance facility ('the stabling and maintenance facility') would be located at the site of the existing Wickham Station (refer to Figure 6.1). The facility would provide for overnight stabling of light rail vehicles, operations and maintenance activities. The site for the facility would occupy an overall area of about 4,500 square metres.

The facility would incorporate four stabling tracks. A building located within the facility would house the following activities:

- management and administration
- operations supervision and control
- maintenance supervision and execution
- parts storage
- staff facilities.

The building would occupy an area of about 20 by 60 metres, and it would be about 12 metres high and 20 metres wide.

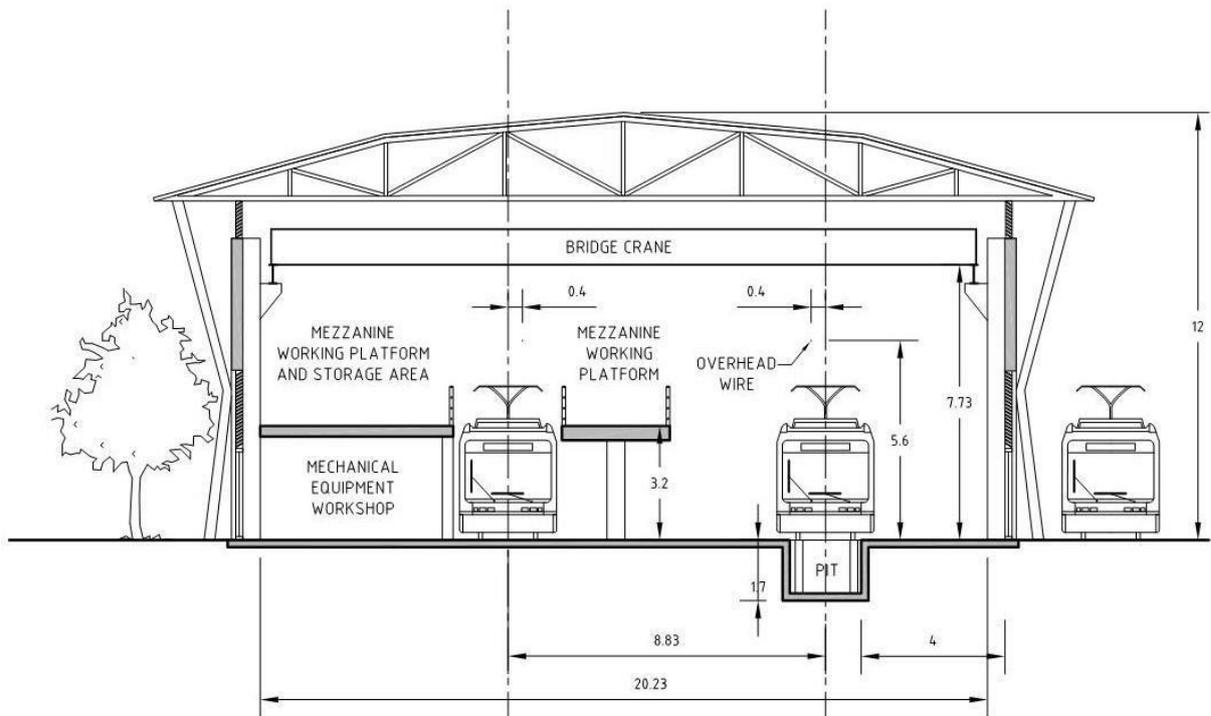
The design of the facility would be refined during the detailed design stage. It is likely that it would comprise a braced portal frame type structure, clad with metal sheeting. The structure may include mezzanine levels, walkways, and inspection pits.

The site would be securely fenced. For safety of operation, vehicle speeds would be limited to five kilometres per hour.

An indicative site layout and cross section is shown in Figure 6.18. An outline of the activities that would be undertaken at the facility is provided in 6.6.2.



Indicative layout



Indicative cross section

Figure 6.18 Stabling and maintenance facility – indicative site layout and cross section of building

6.2.5 Power infrastructure

Substations

Electricity is required to operate the light rail vehicles in the form of direct current power (traction power) of 750 volts. Two 1,500 kilo Volt-Ampere traction substations would be constructed to transform the electricity supplied by the existing Ausgrid supply network to the required form.

The substations would be located within the former rail corridor to the west of Argyle Street. The substation buildings would occupy an area of about 5 by 20 metres each, with the overall site occupying an area of about 15 by 60 metres.

The buildings would incorporate design features and materials to minimise the potential for off-site impacts, including noise and visual impacts. The overall substation site would be fenced and gated, and would include vehicle access and paved areas for parking. The design of the site and structures would be refined during the detailed design stage.

Overhead wiring

Power would be distributed from the substations to the light rail vehicles via overhead wiring strung on poles. A combination of centre poles (poles located towards the centre of the alignment) and side poles (poles located on either one or both sides of the alignment) would be used. The final configuration of the poles and wiring would be determined during the detailed design stage.

Other power requirements

Low voltage 400 volt connections to the Ausgrid distribution network would be required at each stop. The stabling and maintenance facility is likely to require an 11 kilovolt connection and kiosk substation. A supervisory, control and data acquisition (SCADA) system would provide control and monitoring of selected electrical equipment. A remote terminal unit would be located within each substation to transmit data between the operations control room (at the stabling and maintenance facility), and the various electrical devices that are monitored or controlled.

6.2.1 Safety and security

The safety of passengers and the general public has been and will continue to be a key consideration during the design process. Stops have been located and will be designed to ensure visual connectivity along the whole platform and through to the surrounding streetscape and pedestrian networks. To enhance passenger safety, the stops would include the following features:

- CCTV cameras linked to the operations control centre
- an appropriate level of lighting on stops and access ways
- emergency help point
- passenger information signage.

Other security features would include:

- fencing and secure gated entry at the stabling and maintenance facility and the substations site
- bollards positioned strategically around the stops
- corridor fencing where required along the former rail corridor section of the proposal.

A safety and security risk assessment would be undertaken during the detailed design stage to define the safety and security scope of work and design requirements in accordance with relevant standards.

The design and layout of each stop and the stabling and maintenance facility would include consideration of crime prevention through environmental design (CPTED) principles.

The design of the proposal would also incorporate relevant fire and life safety/evacuation requirements.

6.3 Road and transport infrastructure

6.3.1 Buses

Implementation of the light rail network in the Newcastle city centre would require alterations to existing operational bus networks to facilitate the operation of the proposal and minimise the duplication of bus and light rail services along Hunter Street and Scott Street.

Bus stop changes

The location of the bus stops in Hunter Street west of Union Street would remain as they are. East of Worth Place and in Scott Street a number of bus stops would be reconfigured and repositioned. Consultation would be undertaken with Council and the new operator to confirm bus stop locations.

The proposal involves the removal of existing stops at the:

- Southern side of Scott Street west of Market Street.
- Northern side of Scott Street west of Watt Street.
- Southern side of Scott Street west of Watt Street.
- Northern side of Scott Street west of Market Street.
- Northern side of Honeysuckle Drive north of Workshop Way.
- Southern side of Honeysuckle Drive east of Worth Place.
- Northern side of Hunter Street east of Auckland Street.

New stops would be provided at:

- Watt Street north of Scott Street at the former railway station.
- Northern side of Wharf Road at Queens Wharf ferry terminal.
- Southern side of Wharf Road at Queens Wharf ferry terminal.
- Southern side of Centenary Road immediately west of Argyle Street.

Further information on the proposed operational interchange arrangements between the light rail and buses are provided in section 6.5.5.

6.3.2 Pedestrian access and crossing arrangements

Pedestrian access to the stop locations would be provided. Pedestrian crossings have recently been constructed across the former rail corridor at Steel Street, Kuwumi Place, Worth Place, Argyle Street, Perkins Street and Wolfe Street. These would continue to be used following construction of the proposal. New pedestrian access/road crossings to be provided as part of the proposal are listed in Table 6.2.

Table 6.2 Proposed pedestrian crossings and access to stops

Location	Proposed pedestrian access arrangements	Physical works required
Beresford Street	A pedestrian crossing across the light rail corridor on the western and eastern sides of Stewart Avenue at Beresford Street, where the proposal crosses the street after leaving the Wickham Transport Interchange	Install new signals
Steel Street	The existing pedestrian crossing over the former rail corridor between Honeysuckle Drive and Steel Street would be signalised where it crosses the light rail corridor.	Install new signals
Worth Place	A signalised pedestrian crossing of Hunter Street would be provided on the western side of Worth Place as part of the new signalised intersection at Worth Place.	Works undertaken as part of intersection modification
Hunter Street	A signalised pedestrian crossing of Hunter Street would be provided to the west of Wheeler Place	Install new signals
Crown Street	A new signalised pedestrian crossing of Hunter Street would be provided as part of the construction of the Crown Street stop	Road marking undertaken as part of the stop platform works
Market Street	A new signalised pedestrian crossing of Scott Street would be provided at Market Street as part of the construction of the Market Street stop	Road marking undertaken as part of the stop platform works
Newcomen Street	Two signalised crossings of Scott Street would be provided on either side of the Newcomen Street intersection as part of the new signalised intersection	Works undertaken as part of intersection
Pacific Park	A new signalised pedestrian crossing would be provided as part of the proposed Pacific Street signalised intersection	Works undertaken as part of intersection modification works

6.3.3 Proposed road works and road network changes to accommodate the operation of the proposal

The proposed road and intersection modifications that would be undertaken within the proposal site (along the light rail corridor) as part of the proposal to accommodate the operation of the light rail are listed in Table 6.3 and Table 6.4. The other intersection changes outside the light rail corridor that would be undertaken as part of the proposal are described in Table 6.5. These proposed changes are subject to the outcomes of consultation with Council and Roads and Maritime.

The location of the proposed intersection changes along the corridor, and the road network changes outside the corridor, are shown in Figure 6.1 to Figure 6.4.

Other road and traffic arrangement changes and connections are currently outside the scope of the proposal.

Table 6.3 Proposed road configuration changes along the light rail corridor

Location	Existing arrangements	Proposed arrangements	Physical works required
<i>Beresford Street</i>			
Beresford Street	Two lane two way	West of Stewart Avenue – closed to traffic in both directions East of Stewart Avenue – one way for westbound through traffic, with parking and property access retained to the south	Reconfigure roadway for light rail tracks and platforms west of Stewart Avenue and for two light rail tracks and one-lane westbound roadway east of Stewart Avenue
Stewart Avenue to Bellevue Street	Two lane two way	One way for westbound through traffic, with parking and property access retained to the south.	Reconfigure for two light rail tracks and one-lane westbound roadway.
<i>Hunter Street</i>			
Union Street to Worth Place	Eastbound – two lanes with parking Westbound – two lanes through traffic with parking and a bus zone, widening to two through lanes with a left turn lane on the approach to Union Street Intersection	Eastbound – one lane with a widened median and area for parking. A left in left out lane would be provided to allow rear access to private properties Westbound – one through lane with parking, widening beyond the intersection to two lanes, with a left turn to Union Street. Parking would be retained east of the Union Street intersection	Reconfigure roadway for light rail tracks
Worth Place to Auckland Street	Four lane two way with parking on both sides of the road	One lane in each direction, with parking on the northern side of the road removed	Reconfigure roadway for light rail tracks
Auckland Street to Merewether Street	Four lane two way with parking on both sides of the road	One lane in each direction, with parking on both sides of the road removed A dedicated left turning lane would be provided on the eastbound approach to the Merewether Street intersection	Reconfigure roadway for light rail tracks
Merewether Street to Darby Street	Four lane two way with parking on both sides of the road.	One lane in each direction, with parking on the southern side of the road removed A dedicated right turning lane would be provided on the westbound approach to the Merewether Street intersection A dedicated right turning lane would be provided on the eastbound approach to the Darby Street intersection	Reconfigure roadway for light rail tracks
Darby Street to Brown Street	Four lane two way with parking on both sides of the road	One lane in each direction, with the majority of parking on the northern side of the road removed	Reconfigure roadway for light rail tracks

Location	Existing arrangements	Proposed arrangements	Physical works required
Steel Street			
Hunter Street to Honeysuckle Drive	Pedestrian crossing between Steel Street and Honeysuckle Drive	Provide new two-lane, two-way road connection across the former rail corridor	Construct new roadway with footpaths
Worth Place			
Hunter Street to Honeysuckle Drive	Pedestrian crossing between Hunter Street and Honeysuckle Drive	Provide new two-lane, two-way road connection across the former rail corridor	Construct new roadway with footpaths
Worth Place	Short section of road with median parking	Provide new intersection left-in, left-out from Worth Place to Hunter Street	Construct new roadway with footpaths
Scott Street			
Brown Street to Wolfe Street	Four lane two way with a small area of parking on the southern side of the road (immediately west of Wolf Street)	Eastbound – one through lane Westbound – one shared running through lane with parking on the southern side of the road removed	Reconfigure roadway for light rail tracks
Wolfe Street to Newcomen Street	Eastbound – two through lanes narrowing to one through lane with parking at Market Street Westbound – one through lane with parking on the southern side of the road	Eastbound – one through lane West – one shared running through lane with parking on the southern side of the road removed	Reconfigure roadway with changes to on-street parking
Newcomen Street to Watt Street	Newcomen Street to Bolton Street - one lane in each direction with parking on both sides of the road. Bolton Street to Watt Street – two lanes in each direction	One shared running through lane in each direction with parking removed on both sides of the road	Reconfigure roadway with no on-street parking
Watt Street to Pacific Street	One lane in each direction with some parking on both sides of the road	One shared running through lane in each direction with parking removed on both sides of the road	Reconfigure roadway with no on-street parking
Pacific Street to Telford Street	One lane in each direction with some parking on both sides of the road	Eastbound – one through lane with parking to the north to be removed Westbound – one through lane with parking to the south removed	Reconfigure roadway with no on-street parking

Table 6.4 Proposed intersection changes along the light rail corridor

Location	Existing arrangements	Proposed arrangements	Physical works required
Stewart Avenue and Beresford Street intersection	Give way controlled intersection with priority given to Stewart Avenue	Traffic signals on Stewart Avenue at Beresford Lane to allow safe crossing of Stewart Avenue by light rail vehicles	Install new traffic signals
Steel Street at the former rail corridor	No existing road intersection; pedestrian crossing only	New road crossings and traffic signals at the intersection of Steel Street and the light rail corridor	Install new road crossing and traffic signals
Hunter Street and Worth Place intersection	T-junction with a cul-de-sac in Worth Place between the railway corridor and Hunter Street	New traffic signals at the Hunter Street/Worth Place intersection for light rail vehicles to enter Hunter Street Worth Place will open to general traffic and will function as a left-in, left out intersection with Hunter Street	Construct a new T-junction with traffic lanes immediately east of the light rail tracks and install a new traffic signal
Scott Street at Newcomen Street	Give way controlled intersection with priority given to Scott Street	New traffic signals to coordinate change over from separated running to mixed running for eastbound traffic	Install new traffic signals

Table 6.5 Proposed works to roads outside the light rail corridor

Location	Existing arrangements	Proposed arrangements
Honeysuckle Drive westbound at Hannell Street	Signalised intersection	The westbound carriageway of Honeysuckle Drive would be widened locally to cater for greater storage at the intersection.
Honeysuckle Drive at Steel Street intersection	Pedestrian crossing over former railway corridor	The median would be separated to allow right turn travelling eastbound on Honeysuckle Drive. No right turns would be allowed from Steel Street on to Honeysuckle Drive. Left turn from Steel Street and Honeysuckle Drive (westbound) would be allowed. The intersection would be signalised.
King Street between Union Street and Darby Street	Two-lane roadway with on-street parking between Auckland Street and Darby Street	A no stopping zone would be implemented on King Street during weekday AM and PM peak periods. Replacing the existing pedestrian crossing between Civic Park and the Council office building with a signalised crossing would be investigated.
King Street/Darby Street intersection; northbound on Darby Street	Signalised intersection	The island would be adjusted to create a northbound left turn slip lane and dedicated southbound lane in Darby Street.
King Street/Darby Street intersection; southbound on Darby Street	Signalised intersection	Dedicated right turn lane, single through lane, left turn lane using existing slip.

6.3.4 Additional road improvements

The NSW Government will work with Council to confirm a package of additional road improvements that would complement the introduction of the proposal. These improvements would be in addition to those works that currently form part of the proposal (described in section 6.3.3). The areas being considered for additional road improvements are shown in Figure 6.19 and are described as the 'Stewart Avenue precinct' and the 'King Street west precinct'.

The additional road improvements are seeking to address delays to traffic movement at the following locations:

- Stewart Avenue precinct:
 - intersection of Throsby Avenue/Hannell Street
 - intersection of Bishopsgate Street/Stewart Avenue
 - vehicle queuing capacity in Stewart Avenue at various locations, including at the Stewart Avenue/Parry Street intersection.
- King Street west precinct:
 - various intersections to provide additional capacity.

The road improvements would seek to remove existing pinch points in the road network and ensure that traffic continues to move freely and efficiently. The review of options and design of the improvements would aim to maximise the benefits to road users whilst minimising environmental and community impacts.

6.4 Design and development requirements

6.4.1 Urban design

The urban design principles to be adopted during the design process are outlined in the *Design Definition Report* (PB/Aurecon, 2014b). The design of the proposal would:

- be consistent with the principles and strategies of the *Newcastle Urban Renewal Strategy*
- recognise the significance of the study area in the Newcastle city centre urban renewal process
- take into account heritage considerations
- take into account the *Hunter Street Revitalisation Final Strategic Framework* (City of Newcastle, 2010) and *Newcastle 2030* (City of Newcastle, 2013)
- enhance the immediate and broader urban context
- provide for an activated public domain, improved transport opportunities and pedestrian connectivity to existing and proposed local precincts.

The appearance and visual form of the visible features of the proposal have been important considerations in the options assessment and design definition process. The definition design for the proposal has been prepared in accordance with the above principles, and the urban design requirements and objectives of the *Newcastle Urban Renewal Strategy* and the NUTTP.

There would be a separate planning approval process at a later date for the streetscape works, which would include consultation with stakeholders and the community, and would address pedestrian amenity.

The design of the proposal would continue to be refined during the detailed design phase. The final detailed design would integrate all relevant considerations, including:

- security and safety
- functional and operational requirements
- community and stakeholder input
- the role of the proposal in the Newcastle city centre urban renewal and transformation process, and the objectives of the *Newcastle Urban Renewal Strategy*
- urban design and visual impacts
- environmental constraints and sustainability
- access and maintenance requirements
- heritage and the location within the Newcastle City Centre Heritage Conservation Area.

TfNSW's Sustainable Design Review Panel would review the detailed design.

6.4.2 Sustainability in design

One of the objectives of EP&A Act is to 'encourage ecologically sustainable development'. TfNSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of ecologically sustainable development. The principles of ecologically sustainable development are generally defined by clause 7(4) of schedule 2 to the Regulation as:

- The precautionary principle – if there are threats of serious or irreversible damage, a lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation.
- Intergenerational equity – the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- Conservation of biological diversity and ecological integrity – the diversity of genes, species, populations and their communities, as well as the ecosystems and habitats they belong to, should be maintained or improved to ensure their survival.
- Improved valuation, pricing and incentive mechanisms – environmental factors should be included in the valuation of assets and services.

TfNSW has applied, and will continue to apply, the principles of ecologically sustainable development throughout the development and assessment of the proposal. The design of the proposal is being undertaken in accordance with the TfNSW Newcastle Light Rail Sustainability Strategy and the *NSW Sustainable Design Guidelines* (TfNSW, 2014a).

High level sustainability objectives for the proposal are as follows (PB/Aurecon, 2014b):

- reinforce inherent sustainability benefits – the design would promote interchange, urban renewal and active transport
- achieve TfNSW's sustainability targets – including design and construction initiatives, sustainable procurement and workforce development
- achieve a 'gold' rating in accordance with the *NSW Sustainable Design Guidelines*

- achieve an 'excellent' in accordance with the Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability Rating Tool
- offset carbon emissions from electricity – aim to offset a minimum of 25 per cent of construction electricity emissions and a portion of operational electricity emissions
- collaborate with governments and stakeholders.

A sustainability assessment of the proposal was undertaken in accordance with the *NSW Sustainable Design Guidelines*, as outlined in section 15.8. The results indicate that a gold rating in accordance with the *NSW Sustainable Design Guidelines*, and an excellent rating in accordance with the ISCA Infrastructure Sustainability Rating Tool, are both achievable for the proposal. TfNSW would aim to offset 100 per cent of operational electricity emissions through the purchase of accredited renewable energy suppliers.

6.4.3 Design standards

The proposal would be designed, constructed and operated in accordance with the current standards of the following agencies, as applicable:

- Australian Standards
- Building Code of Australia
- Asset Standards Authority
- TfNSW
- Council (for the public domain)
- Roads and Maritime
- utility companies or asset owners.

The design would only depart from the specified standards with the agreement of the relevant authority.

6.4.4 Property acquisition and subdivision

The majority of land within the proposal site (the former rail corridor, Hunter and Scott streets) is owned by the government agencies. Very little acquisition of private property is required. Acquisition requirements are summarised in Table 6.6. Subdivision of these lots may also be required. Following completion of construction, if a part of any lot is identified as surplus to operational requirements or requires a boundary adjustment, detailed Deposited Plans of subdivision would be developed and lodged with Land and Property Information for the subdivision of the land. It is noted that TfNSW is a subdivision authority in accordance with section 109D of the EP&A Act.

Table 6.6 Land acquisition

Site address	Site ref	Ownership	Existing use	Proposed use/proposal feature	Acquisition type	Acquisition area (approx) (m ²)
Stewart Avenue	Road (part)	Council	Road	Stabling and maintenance facility	Strip	To be confirmed
18 Honeysuckle Drive	Lot 2000 DP 1145678 (part)	Hunter Development Corporation	Vacant land	Stabling and maintenance facility	Strip	To be confirmed
540 Hunter Street (near Worth Place)	Lot 2 DP 1037267 (part)	Hunter Development Corporation	Vacant land	Light rail route (Worth Place turnout)	Full	450
538 Hunter Street, (near Worth Place)	Lot 1 DP 1037267	Private	Vacant land	Light rail route (Worth Place turnout)	Full	430
20B Wright Lane (near Worth Place)	Lot 21 DP 1165985 (part)	Hunter Development Corporation	Vacant land	Light rail route (Worth Place turnout)	Strip	To be confirmed

6.5 Operation of the proposal

The operator would be responsible for the safe and efficient operation of the proposal and the safety of customers. The operator would produce a safety management system and a full suite of operational rules, procedures and manuals, describing how the proposal would be operated and maintained. Operation of the proposal would be guided by a comprehensive risk management strategy including standard risk and safety mitigation measures and plans (such as incident and emergency response plans).

6.5.1 Demand forecasts

The proposal would have the capacity to move at least 600 people per hour in each direction during daytime weekday hours, with a minimum of 100 passengers per light rail vehicle. Current passenger projections are summarised in Table 6.7. It is noted that the resident and employee population in the study area will increase into the future, which will in turn increase demand. This population increase is projected as a result of the urban transformation activities being undertaken as part of the NUTTP, and as a result of the existing and proposed major developments in the vicinity of the proposal site (refer to section 14.2).

Table 6.7 Patronage projections

Year	Passengers per hour
2021	300 to 430
2036	370 to 530

6.5.2 Light rail vehicles

A fleet of five vehicles would operate along the route, with four vehicles operating and one spare vehicle available for use if required and/or to rotate into service during maintenance activities. The vehicles would be procured using proven 'off the shelf'-type vehicles, similar to those operating in Sydney along the Inner West route. The vehicles would have a standard low-floor design with overhead traction power. Each vehicle would be equipped with modern passenger surveillance and communication systems. They would have full disability access provisions and would incorporate heating and air conditioning.

The indicative characteristics of the light rail vehicles are provided in Table 6.8.

Table 6.8 Indicative light rail vehicle specifications

Feature	Indicative characteristics
Vehicle model	Low floor
Vehicle capacity (minimum)	100 passengers
Nominal vehicle length	30 m
Vehicle width and height	2.65 m wide and 3.6 m high
Maximum speed	Up to 60 km/h in the former rail corridor, and up to 40 km/h for in-street running
Driver position	Driver cab at each end

6.5.3 Hours of operation

The proposal would operate as follows:

- light rail services would commence at 5am and finish at 1am
- between the core hours of 7am and 7pm, services would operate every 10 minutes on weekdays and every 15 minutes on weekends
- less frequent services would be provided in the early morning, evening and night periods.

The minimum service frequency is summarised in Table 6.9.

Table 6.9 Minimum service frequency

Time period (24 hours)	Monday to Friday	Saturday	Sunday	Public holiday
00:00-01:00	30 mins	30 mins	30 mins	30 mins
01:00-05:00	Nil	Nil	Nil	Nil
05:00-07:00	15 mins	30 mins	30 mins	30 mins
07:00-19:00	10 mins	15 mins	15 mins	15 mins
19:00-24:00	15 mins	15 mins	30 mins	30 mins

6.5.4 Road network integration and traffic signalling

The safe integration of the light rail corridor with other road users (vehicles and pedestrians) has been, and will continue to be, a major consideration of the design process and operational planning. For the majority of the route (about 2.2 kilometres), the light rail corridor would be either segregated or separated from road vehicles. This would provide an operating environment that is free from the impacts of road congestion. At intersections and in the small section of shared running in Scott Street, the light rail corridor would share the road with other road users.

Separating the light rail corridor from other road traffic would be achieved in the road corridor using road markings with different surface finishes/colours. Emergency vehicles or road traffic would be able to cross the light rail corridor (in the event of an emergency or if road traffic is diverted into the light rail vehicle lane as a result of a blockage in the adjacent road traffic lane).

The proposed changes to the road network and intersections are described in section 6.3.3.

The traffic and light rail signals would be designed to integrate and support the operation of the light rail system whilst minimising the impact on other road users.

The design and operation of new traffic signals would be undertaken in accordance with Roads and Maritime standards.

6.5.5 Interchange with other public transport facilities

When light rail is implemented, the bus network within the city centre would be reconfigured so that most bus routes do not duplicate light rail services in the Hunter Street corridor. Four of the local bus routes would continue to service Newcastle East at Parnell Place.

Once the Wickham Transport Interchange is complete, heavy rail services would terminate at the interchange, and light rail passengers would transfer to the light rail via the Wickham light rail stop on the southern side of the interchange.

Further information is provided in chapter 8 and Technical Paper 1.

6.5.6 Ticketing and passenger information

The ticketing system would integrate with the Opal card electronic ticketing system. Opal card top-up machines would be installed at selected stops. The location of the Opal card top-up machines would be determined during detailed design.

Validators for the Opal card system would be located on platforms and passengers would be required to validate their card before boarding the light rail vehicles.

6.5.7 Workforce

Operation of the proposal would require a workforce of about 60 people.

6.6 Maintenance

6.6.1 Track and stops

Maintenance would be required at times along the light rail corridor. Maintenance activities would include:

- Regular activities such as track and overhead wiring inspections, and inspection and cleaning of the track drainage system.
- Preventative maintenance and minor repairs to infrastructure components as required.
- Cleaning of passenger facilities.
- Track maintenance and periodic replacement of track and other light rail infrastructure.

6.6.2 Maintenance activities at the stabling and maintenance facility

Work undertaken at the facility would involve scheduled maintenance and running repairs. No major overhaul or body repair work/painting would be undertaken at the facility.

Scheduled maintenance would involve time and/or kilometre-based inspection and maintenance activities as prescribed by the original equipment manufacturer. Activities would include checking the condition of wear-and-tear components, replenishing consumables, and general equipment and operational checks. Scheduled maintenance may also include component replacements and upgrades that can be planned and executed in a structured manner.

Running repairs, or unscheduled maintenance, would involve replacing failed components and parts, recalibrating malfunctioning equipment, and repairing or replacing damaged equipment and materials. Damage could occur as a result of friction, vibration, fatigue, water intrusion, overheating, impact with foreign objects, accidents, vandalism etc.

7. Construction of the proposal

This chapter provides an outline of the main activities that would occur during construction of the proposal. It includes a summary of the proposed timing, an indicative construction methodology, likely resources and proposed access arrangements. This information is preliminary only and is based on the information provided by the design team. The construction methodology will be refined as the design of the proposal progresses. The construction contractor may also propose alternative methods. Any substantive changes proposed to the construction methodology may require subsequent environmental impact assessment.

7.1 Outline approach

Construction of the proposal is anticipated to be undertaken over a period of 2.5 years commencing in late 2016, with operations commencing in early 2019. An indicative construction program is shown in Figure 7.1.

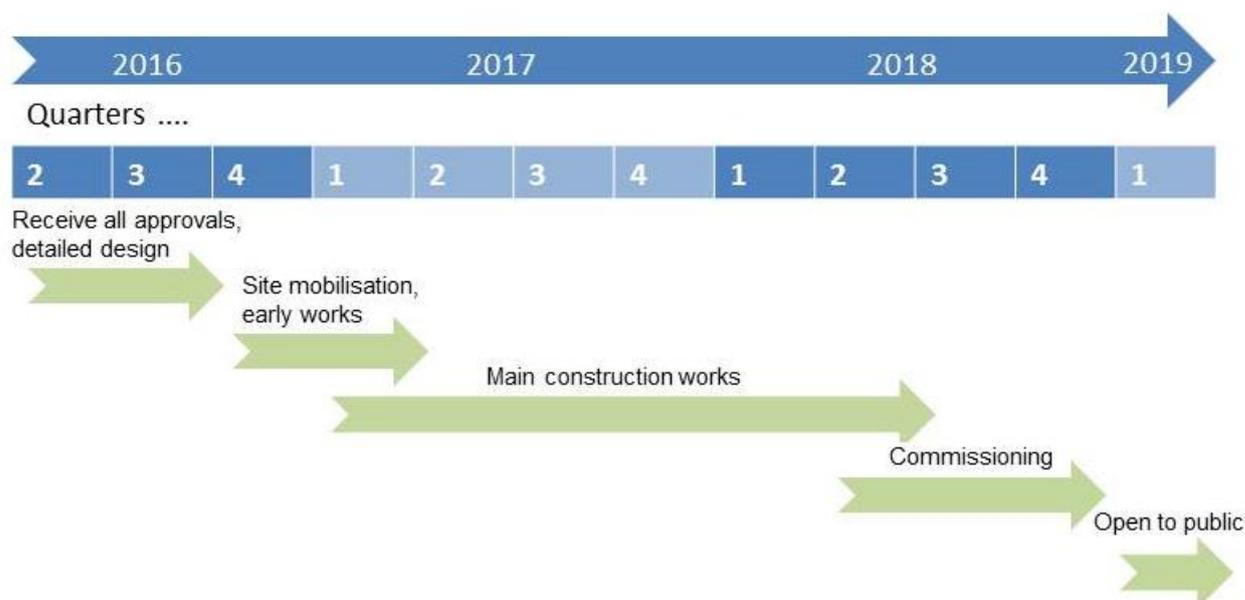


Figure 7.1 Indicative construction program

It is anticipated that construction would generally progress from west to east in each construction zone, and involve three main work phases:

- early works
- main construction works
- testing and commissioning.

These broad work phases are described in more detail below.

Some overlap between these work phases may occur to ensure the proposal is completed as quickly as possible.

It is anticipated that construction activities would be undertaken concurrently within the four main work zones shown in Figure 7.2 to Figure 7.5 and listed in Table 7.1.

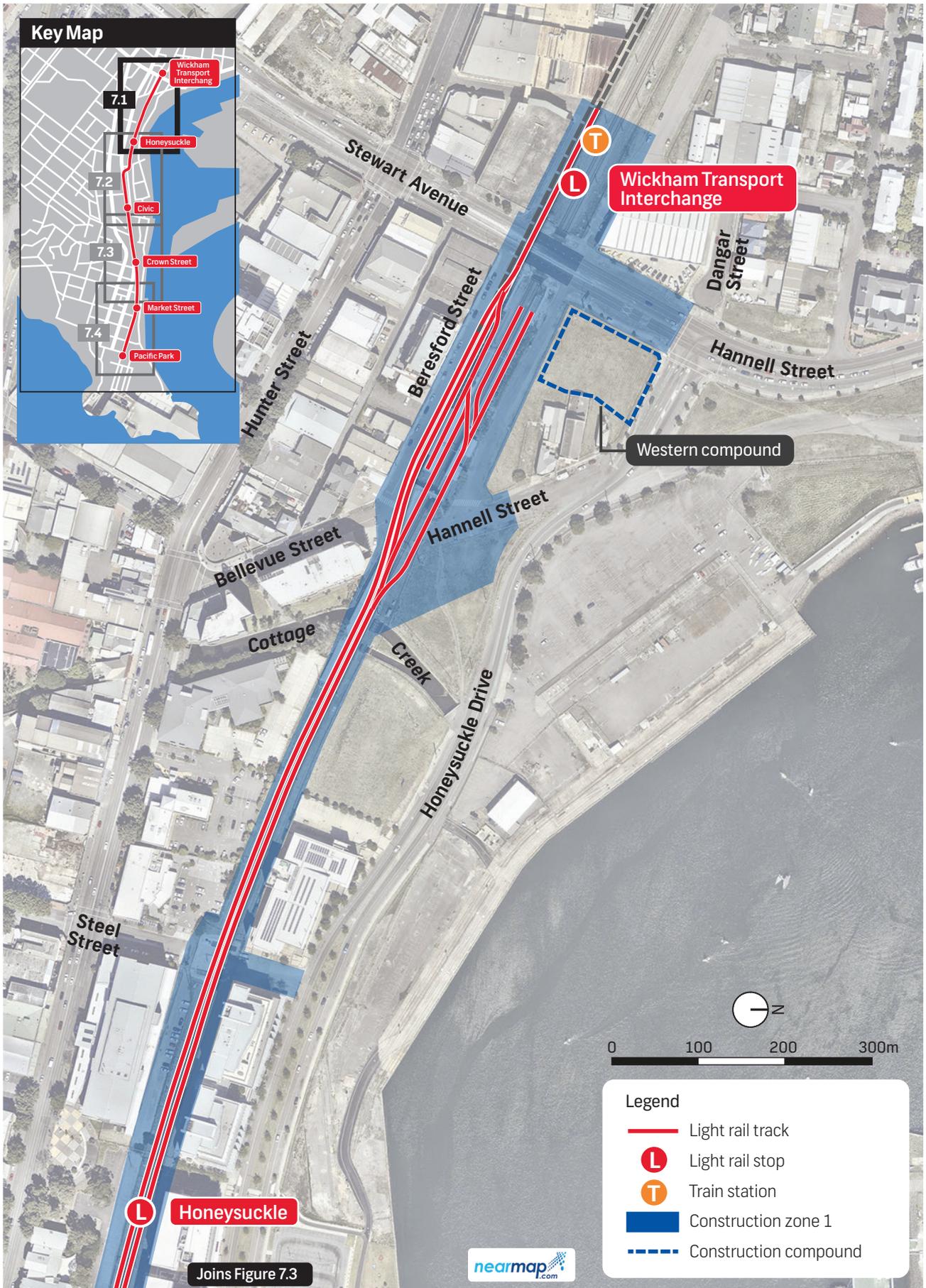


Figure 7.2 Construction zone 1 and western compound site

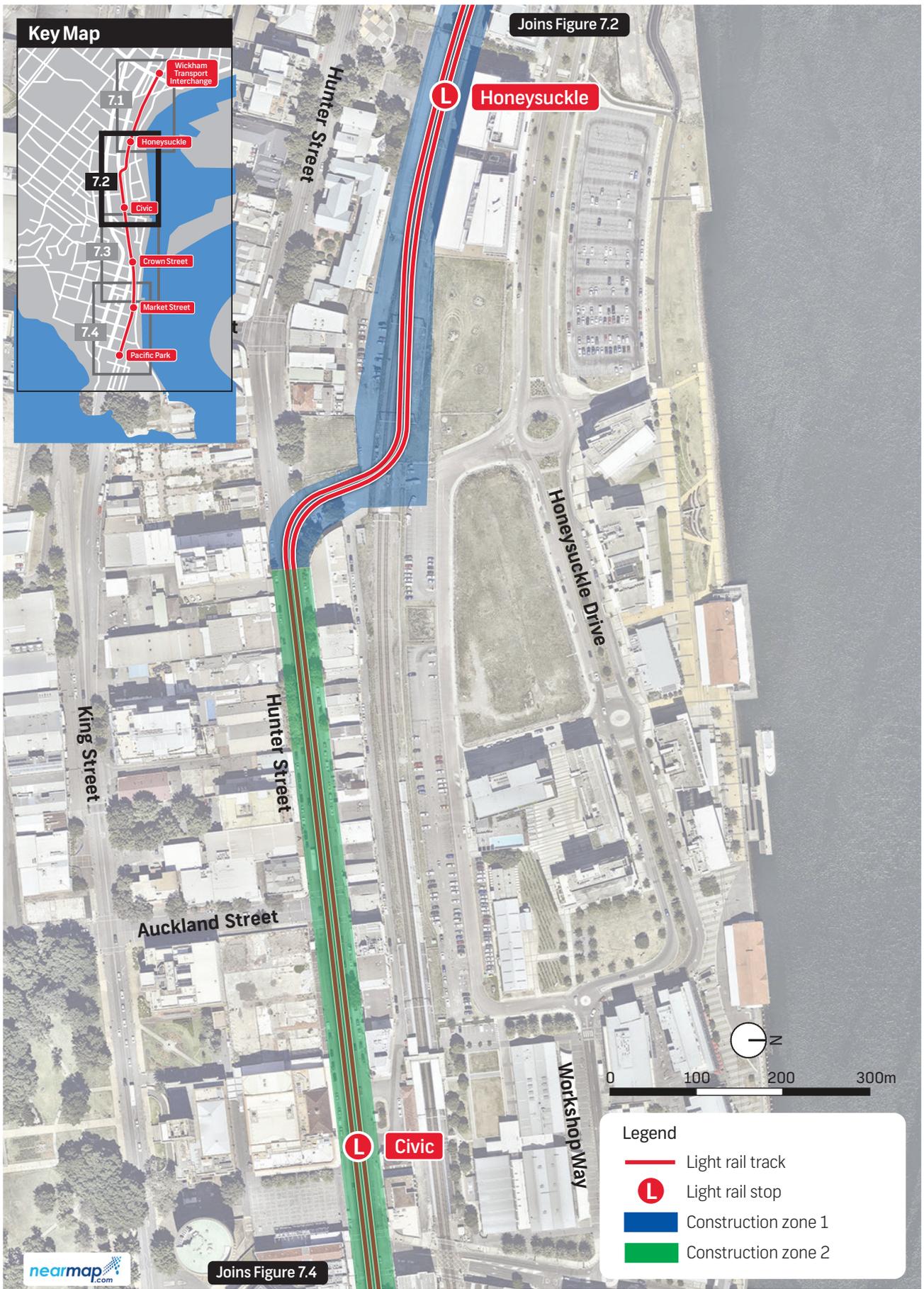


Figure 7.3 Construction zones 1 and 2

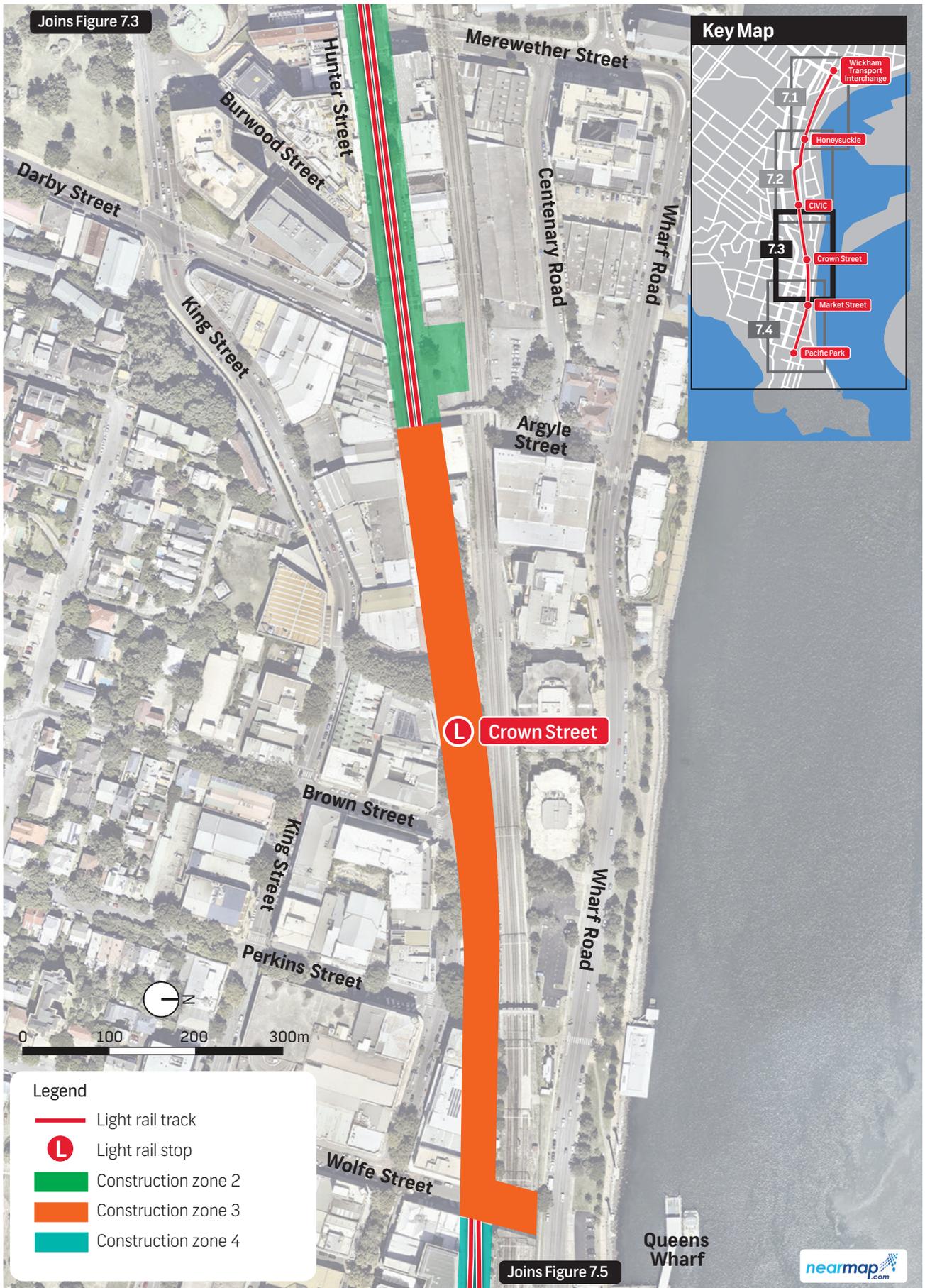


Figure 7.4 Construction zones 2, 3 and 4

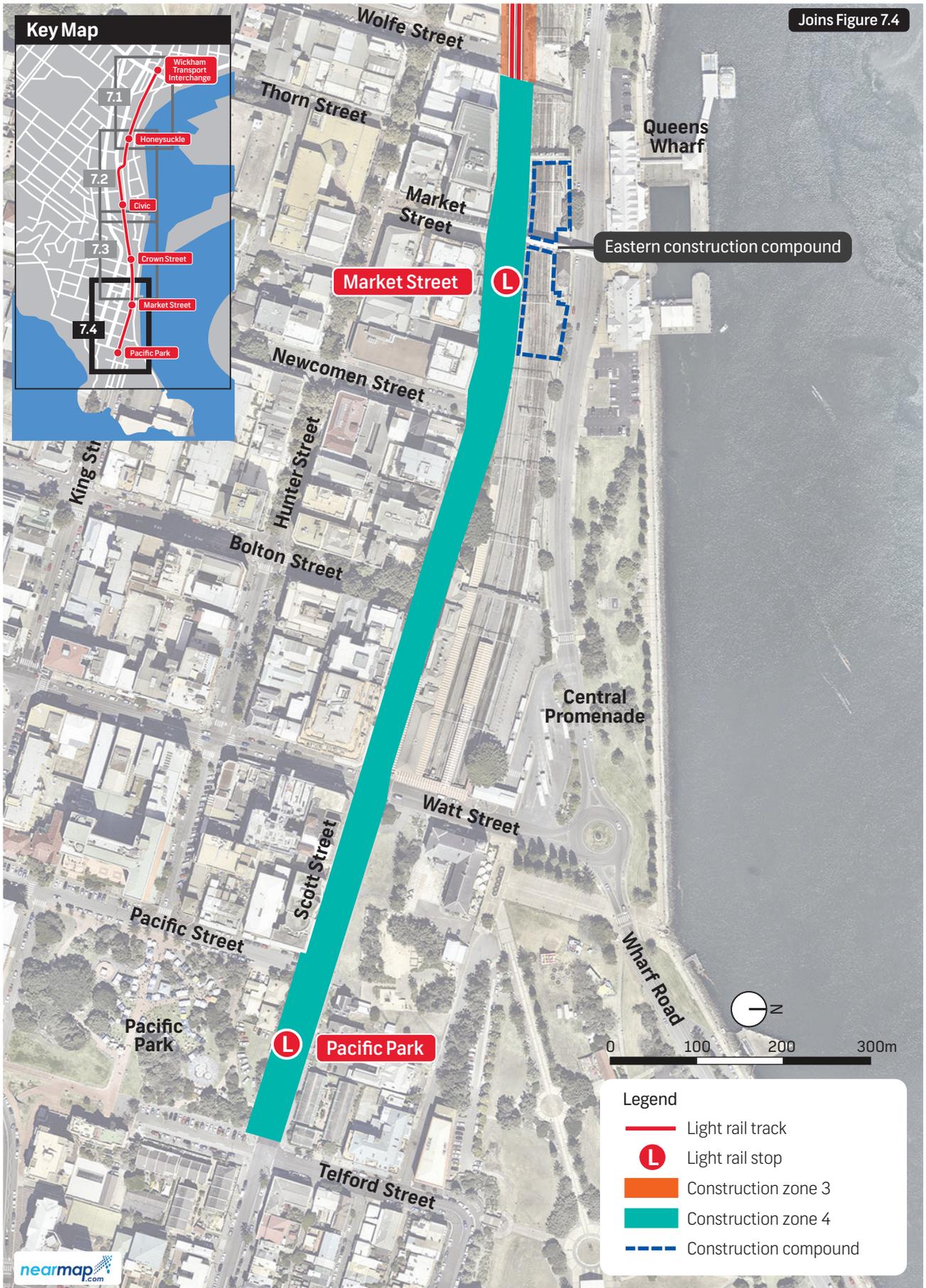


Figure 7.5 Construction zones 3 and 4 and eastern compound

Table 7.1 Construction work zones

Work zone		Description
1	Former rail corridor and stabling and maintenance facility	Extends from Wickham Transport Interchange, via Beresford Street and along the former rail corridor to Worth Place. The total length of this area would be about 970 m. The width of the works area within Beresford Street would be about 4 m.
2	Hunter Street west	Extends along Hunter Street from Worth Place to Darby Street. The total length of this area would be about 650 m. The width of the work area would be about 8 m.
3	Hunter Street east	Extends along Hunter Street from Darby Street, into Scott Street to Wolfe Street. The total length of this area would be about 500 m. The width of the work area would be about 8 m.
4	Scott Street	Extends along Scott Street from Wolfe Street to the end of the route just past the Pacific Park stop. The total length of this area would be about 650 m. The width of the work area would be about 8 m.

Construction would progress concurrently in each zone along the proposal site in approximately 100 metre lengths, at a rate of about 50 metres a month.

In zones 2 to 4, where works are undertaken along the roadway, construction would be undertaken along one side of the road at a time.

Changes to parking and loading zones are required to provide sufficient width for construction activities and to maximise the width of traffic lanes available. A single 3.2 metre wide road lane would be maintained in each direction in the vicinity of the roadway construction zones.

Temporary relocation of affected bus stops may be required during the works. 24 hour access would be maintained at all times for emergency services vehicles and facilities.

The indicative construction site boundary is shown in Figure 7.2 to Figure 7.5.

7.2 Construction methodology

An indicative construction methodology is outlined in the following sections. The construction methodology would be further developed by the appointed construction contractor/s.

7.2.1 Early works

Early works are required to establish the main work areas and enable the main construction works to proceed with minimal delay. Early works would commence after all relevant approvals have been obtained, and are likely to include:

- topographical survey
- installation of environmental and traffic controls in accordance with the CEMP and any conditions of the determination for the proposal
- site mobilisation and establishment
- services investigations, protection and/or relocations
- facilitating changes to traffic and bus movements through and across the work sites
- removal of the pedestrian bridge over the former rail corridor to the west of Market Street
- removal of the existing Wickham Station buildings, platforms and pedestrian overbridge

- construction of lighting and traffic signals at crossings
- installation of the high voltage feeder for the proposed substations
- remediation works as required
- road works as required.

Early works would occur concurrently where required throughout the proposal site. The works would be staged to minimise impacts to traffic flow. It is anticipated that early works at intersections would be undertaken during weekends, night-time, or during holiday periods to minimise impacts to traffic flows.

7.2.2 Main construction works – light rail alignment

Within each work zone, the main construction works would generally involve the following stages:

- civil works and earthworks (where required)
- track installation
- overhead wiring and posts
- stop construction
- services installation.

An overview of these stages is provided below. Within each zone, works would typically be undertaken progressively, generally from west to east. Exceptions may be required at key locations such as at key road intersections.

Civil works

Civil works would generally involve:

- sawcutting the existing road pavement and excavation of the subgrade/foundations for the light rail tracks
- installing services conduits
- backfilling areas of excavation
- constructing drainage
- preparing the track bed
- concrete pumping and/or pouring
- temporary reinstatement of affected areas, as required.

Earthworks

At this stage of the design process, it is estimated that about 18,500 cubic metres of material would be excavated during construction. Where feasible, the excavated material would be re-used as fill for backfilling excavations. If the excavation is not suitable for re-use, fill would need to be imported, and excavated material exported for re-use on other sites, treatment or disposal, depending on the type and classification of the excavated material.

It is estimated that about 9,500 cubic metres of fill would be required.

Surplus excavated material that cannot be reused would be disposed of to the Summerhill Waste Management Centre at Wallsend.

Track installation

The nature of the track installation would differ according to the location (within the former rail corridor or within the road corridor). The installation works would generally involve:

- track laying, welding and finishing
- installation of rail boots in embedded track form (where applicable)
- installation of overhead wiring foundations and posts, where required (see below)
- rail systems installation
- permanent reinstatement of affected areas, including installation of road line markings.

Within the former rail corridor, track levels would generally follow the existing ground profile and use a conventional sleeper and ballasted track form. Within the stabling and maintenance facility and through the Honeysuckle stop, a grooved rail founded on either a reinforced concrete slab or on sleepers cast into a base slab is proposed.

Within the Hunter Street and Scott Street road reserve, the proposal would be constructed to the existing road levels:

- The existing pavement would be broken out to the required depth and replaced with a reinforced concrete track slab.
- A grooved rail founded on either a reinforced concrete slab or on sleepers cast into a base slab would be installed.
- The existing asphalt layer of the road would be locally milled and replaced where necessary between the track slab and the existing kerb line.

Generally, the tracks would be installed in linear sections, with disruption contained within the work area (which would move at a rate of about 50 metres per month). The varying design of the proposal within the existing road reserve means that the light rail tracks may be either installed together, or each track may be installed separately. Therefore, more than one work period at any location within a work zone may be required.

Overhead wiring and posts

Posts for new overhead wiring and any additional street lighting would be constructed either during the civil works (undertaken during the excavation of footpaths for utility relocations) or during the track installation stages.

Construction activities would typically involve:

- sawcutting the existing footpath or road pavement and excavation to install the post footings
- placing the reinforcement cage, base plate and other reinforcement structures
- concrete pouring
- offsite fabrication of overhead wiring post and delivery to the worksite
- fit-out of overhead wiring post
- erection of posts
- stringing overhead wires, installation of droppers and wiring terminations.

This activity would require localised part road closures of up to a week at a time.

Light rail stops

Stop construction is likely to consist of prefabricated materials and on-site concrete pours. This work is anticipated to require up to three months to complete in each location, depending on the size and finish specified.

Construction activities would typically involve:

- installing services and conduits
- establishing localised traffic controls
- sawcutting, scabbling and excavation of existing pavement
- piling (as required)
- formwork
- construction of footings
- concrete pouring
- installing the prefabricated stop canopy, signage, seating, tactile indicators and paving
- finishing works.

7.2.3 Construction of other facilities

Construction of the stabling and maintenance facility

Construction of the stabling and maintenance facility may be undertaken concurrently with the main construction works to enable delivery and testing of light rail vehicles. Construction activities would typically involve:

- implementation of heritage management measures (refer section 10.4)
- removing existing buildings and structures on site
- utilities relocation, protection and modification
- remediation of the site (if required)
- clearing and grubbing the construction footprint
- earthworks and installation of site drainage
- establishing site roads and access
- excavation for buildings
- construction of foundations
- utilities supply to the site (where required)
- construction of buildings and water treatment facilities
- formation, track work and the construction of footpaths (for staff access) and foundations for railway systems (overhead wiring structures and signalling equipment)
- installing rail systems (power distribution, overhead wiring and signalling) and flood lighting
- installing maintenance equipment
- landscaping
- building fit-out, including installation and connection of electricity/communications, water and sewer systems.

Construction of this facility would take about 12 months to complete.

Substations and associated works

Construction of the substations would generally involve the use of prefabricated structures, with the manufacture and fit-out of each substation occurring off-site. On-site works would typically comprise excavation, foundation preparation and construction, and the installation of conduits and other in-situ works prior to the installation of the prefabricated substation building.

Construction activities would typically involve:

- establishing the worksite, temporary hoardings, construction pad and laydown area
- excavation for below-ground components
- constructing foundations, footings, conduits and other in-situ works
- installing earthing and lighting systems
- delivery and installation of prefabricated substations/transformers
- installing high voltage cables between substations and the location cabinets situated at each light rail stop, as well as to existing Ausgrid substations within the network
- the supply, installation and termination of low voltage power and control cabling between equipment
- backfill around substation with concrete, pavers, or other materials depending on finished surface
- post construction testing and commissioning.

Landscaping and public domain works

Landscaping and public domain works would generally commence as a final stage of work, which would be progressively undertaken as sections of construction work are completed.

7.2.4 Testing and commissioning

Testing and commissioning of the light rail vehicles and systems would be undertaken by the construction contractor in line with contractual obligations.

The light rail vehicles would be tested initially on the track between the stabling and maintenance facility and Worth Place. The other key aspect of commissioning would be testing of the light rail signalling systems.

7.3 Construction resources

7.3.1 Plant and equipment

Plant and equipment used to construct the proposal may include (but not be limited to):

- hand compactor
- excavator and hydraulic breaker
- water cart
- concrete saws
- backhoes
- hand tools concrete pumps
- air compressors
- generators
- road sweepers

- piling rig
- front end loaders
- mobile cranes
- scaffolding
- vibratory rollers
- excavator
- rail saw
- concrete agitator trucks
- hiab trucks
- bobcats
- scissor lifts
- dozers grader
- rail grinder and regulator
- dump trucks
- tip trucks
- bitumen sprayer
- asphalt profiler
- vacuum truck
- franna cranes
- slipform concrete machine
- trenching machine.

7.3.2 Construction workforce

It is anticipated that up to about 100 workers would be required on-site during the peak construction period. An average of about 70 workers would be required at other times. It is likely that separate crews would undertake construction in each zone concurrently, and at times, on multiple work stages.

7.3.3 Working hours and out of hours work

Construction would generally occur during the standard working hours set out in the *Interim Construction Noise Guideline* (DECC, 2009):

- Mondays to Fridays between 7am and 6pm.
- Saturdays between 8am and 1pm.
- No work would normally occur on Sundays or public holidays.

As a result of the location of the works and the need to keep critical road intersections operational during peak traffic periods, some works during the night-time and over consecutive weekend nights (out of hours work) would also be required. This is likely to include Stewart Avenue/Hannell Street at its intersection with the light rail corridor. Other critical intersection locations which may be similarly affected include Watt Street, Merewether Street and Darby Street, subject to the outcomes of traffic modelling and the construction methodology proposed by the construction contractor.

Other works that may be required outside standard working hours include certain electrical connections and installation; delivery and/or removal of oversized equipment; and works required by utility service providers or where impacts to services cannot be reasonably managed during standard working hours.

The contractor would obtain approval from TfNSW for all out of hours work. All out of hour works and activities would be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (TfNSW, 2012). Management measures for out of hours work are provided in Table 16.1.

7.3.4 Fencing

The construction sites and compounds would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions.

7.4 Construction compounds

Two construction compounds are proposed as shown on Figure 7.2 and Figure 7.5:

- Eastern compound – a site within the former rail corridor located just west of Newcastle Station.
- Western compound – a site located on currently vacant land adjacent to Hannell Street and Station Street.

Each compound would include a site office and first aid room, lunchroom, ablutions facilities, lighting, storage, and workshop space. The compounds would be securely fenced and have security patrols. Signage would be erected advising the general public of access restrictions.

The eastern compound would be accessed from Scott Street and Wharf Road where possible. The western compound would be accessed from Honeysuckle Drive and Hannell Street. Worker car parking would be provided at the western compound site. From there, workers would be shuttled to the worksites in each construction zone to reduce traffic and parking impacts.

Once a construction contractor has been selected, the location of the proposed construction compounds may be reviewed. Should the locations (or number of sites) differ from the locations considered by this REF, consultation would be undertaken with TfNSW to confirm the suitability of the proposed location and whether any additional environmental impact assessment is required.

7.5 Construction traffic, transport and access management

A summary of the proposed arrangements for construction traffic management is provided below. Further information, including a summary of the potential impacts of construction, is provided in chapter 8.

7.5.1 Construction traffic management

Prior to the commencement of construction, a construction traffic, transport and access management plan would be prepared in consultation with relevant stakeholders and in accordance with relevant standards as part of the CEMP. The traffic and transport management plan would provide information on traffic flow, vehicle moments, site access and parking arrangements during construction, and the measures to minimise the impacts on the surrounding road network. Further information is provided in sections 8.4 and 16.3.

7.5.2 Construction site access and parking

Vehicle movements would be limited at each location to maintain satisfactory levels of safety and to minimise traffic congestion. Maximum speed limits would be imposed and signage used to limit unnecessary vehicle movements, in accordance with the construction traffic, transport and access management plan.

As noted in section 7.4, an area at the western site compound would be dedicated for worker parking. A designated parking area may also be provided adjacent to the former rail corridor. Workers would be transferred to the worksites from the parking location/s by the contractor. Workers would also be encouraged to use public transport (where feasible) to minimise parking requirements.

7.5.3 Vehicle movements

Construction vehicle movements would comprise heavy vehicles (including construction plant and deliveries of larger items, removal of spoil/waste etc) and light vehicles (including deliveries of smaller items and staff vehicle movements).

The estimated number of heavy vehicles is about 8 to 12 vehicles per zone per day, with an overall daily total for the proposal site as a whole of 38 heavy vehicles. These heavy vehicles would be distributed over the working day and would be managed by traffic control staff as specified in the construction traffic, transport and access management plan. Light vehicle movements (particularly staff) would be mainly directed towards the compound/s. A breakdown of the estimated traffic movements is provided in Table 7.2.

Table 7.2 Indicative construction vehicle movements

Construction zone	Estimated vehicles per day	
	Heavy vehicles per day	Light vehicles per day
1	12	20
2	9	
3	9	
4	8	
Compound	-	80
Total	38	100

7.5.4 On-street parking

Operation of the proposal would require removal of on-street parking, mainly along Hunter Street and Scott Street (but also in other locations). Where parking needs to be removed for construction works, and it is not intended to be replaced following commencement of operation, it would not be replaced for the remainder of the construction period. This is to limit unnecessary change and uncertainty over parking availability.

7.5.5 Operation of the shuttle bus associated with the Wickham Transport Interchange

At this stage, no changes are proposed to the current routing of the shuttle bus taking people from Newcastle Station to Hamilton Station during construction. Following the opening of the Wickham Transport Interchange (scheduled for mid-2017), and when the new heavy rail timetable and stopping pattern is introduced, TfNSW would have the option of terminating the shuttle bus at the new interchange or maintaining the existing shuttle bus stops and route until completion of the proposal. A review of these options would be undertaken closer to the opening of the new interchange.

7.5.6 Bus routes and stop locations

During construction, it is intended that buses would continue to operate along their current routes using the traffic lane that would be maintained along Hunter and Scott streets. It would be necessary to undertake temporary relocations of some bus stops to avoid worksite locations. It is likely that this would involve moving the stops about 50 metres east or west at a time. Where a bus stop is to be permanently relocated or removed following commencement of light rail operations, it would be removed as necessary during construction and not replaced for the remainder of the construction period. This is to reduce unnecessary change and uncertainty over bus stop locations.

7.5.7 Pedestrian and cyclists

For the majority of the main construction works, existing pedestrian and cycle movements along footpaths would be maintained.

Where the installation of infrastructure and services encroach onto the footpath, the footpath could be temporarily narrowed past the worksite, and pedestrians and cyclists diverted using appropriate barriers and signage. Alternatively, temporary structures could be installed to facilitate access over the worksites. The requirements of the *Disability Discrimination Act 1992* would be adopted. Footpath widths would be sufficient to allow two-way pedestrian traffic, with space to accommodate prams and wheelchairs.

Part C

Environmental impact assessment

8. Traffic, transport and access

A transport, traffic and access assessment of the proposal was undertaken by GHD. A comprehensive technical report is available as 'Technical Paper 1 – Transport, Traffic and Access Assessment' on the TfNSW website (www.transport.nsw.gov.au). A summary of the assessment is provided in the following sections.

8.1 Assessment approach and methodology

The assessment involved:

- Reviewing the concept design for the proposal.
- Conducting site visits to identify land use, properties and access adjacent to the proposal site, and to conduct an audit of on-street parking spaces, loading zones and side street parking.
- Investigating travel characteristics and road and intersection performance using Paramics and SIDRA models respectively for the city centre.
- Obtaining additional traffic counts at selected intersections.
- Investigating the demand for public transport using recent data on train, bus and shuttle bus patronage.
- Determining the travel demand for vehicular traffic based on the land use during the construction period, when the light rail becomes operational, and ten years into the future.
- Meeting key stakeholder agencies, including Roads and Maritime and Council, to discuss potential traffic, transport and access impacts.
- Assessing the potential impacts using the road network model developed for the proposal.
- Identifying mitigation measures to address the impacts identified.

The extent of the traffic modelling area is shown in Figure 8.1. The traffic modelling was prepared by GHD on behalf of TfNSW with a technical review by Roads and Maritime. The changes to the road network were discussed with Roads and Maritime and Council.

Traffic volumes were modelled for the predicted year of opening and ten years after opening. At the time the modelling was undertaken, the predicted year of opening was 2018. Subsequent to the modelling, the planned opening for light rail was put back from 2018 to early 2019 due to the delay caused by court proceedings during 2015. It is noted that the modelled year of opening (2018) is equivalent to the currently predicted year of opening of 2019, and the change in the predicted opening date does not impact on the modelling results.

The proposal assessed for the purposes of the traffic, transport and access assessment is as described in chapter 6.

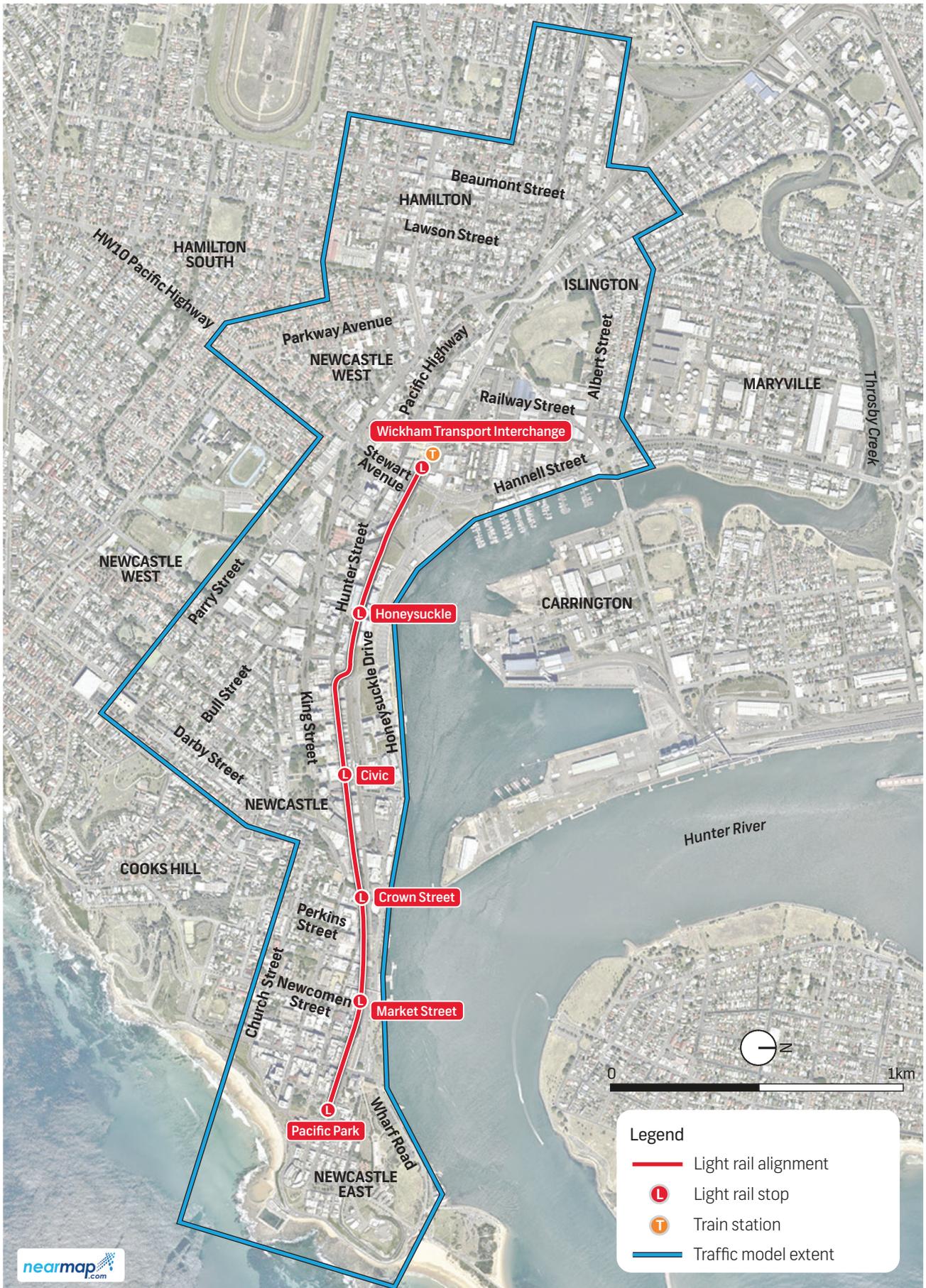


Figure 8.1 Traffic, transport and access assessment modelling area

8.2 Existing environment

8.2.1 Key roads

Key roads in the study area

Council is the roads authority for all public roads (both classified and unclassified) within and in the vicinity of the proposal site. Roads and Maritime may exercise the powers of a roads authority in respect of roads classified under the *Roads Act 1993*. Classified roads in the vicinity of the proposal site are:

- the Pacific Highway - consisting of Stewart Avenue south of Hunter Street, Hunter Street west of Stewart Avenue, and Maitland Road
- Hannell Street and Industrial Drive
- Parry Street and Donald Street.

Detailed descriptions of the key roads and intersections are provided in Technical Paper 1.

Existing traffic volumes

Traffic volumes on key roads within the study area are listed in Table 8.1. Details of estimated traffic volumes at other intersections are provided in Figure 2-2 and Appendix C in Technical Paper 1.

Table 8.1 Estimated 2015 ADT traffic volumes

Street	Daily traffic (vehicles per day)	AM peak (vehicles per hour)	PM peak (vehicles per hour)
Stewart Avenue south of Honeysuckle Drive	29,500	2,538	2,738
Hunter Street west of Steel Street	18,300	1,377	1,590
Hunter Street east of Steel Street	18,300	1,305	1,507
King Street east of Union Street	13,700	951	946
Hunter Street east of Darby Street	18,100	1,254	1,615
King Street east of Darby Street	12,500	934	1,473

Source: Skyhigh traffic surveys June 2014 and March 2015

The results indicate that there is slightly more traffic using the roads during the PM peak than during the AM peak.

8.2.2 Key intersection performance

The performance of the road network is largely dependent on the operating performance of intersections which form critical capacity control points in the road network. Level of service is the standard measure used to assess the operational performance of the network and intersections. There are six levels of service, ranging from level of service A to level of service F. Level of service A represents the best performance, and level of service F the worst. A level of service of D or better is generally considered to be an acceptable level of service.

Level of service E may also be acceptable during peak periods. Levels of service E or F generally refer to intersections operating at, or close to capacity.

The existing performance of the key intersections within the study area is summarised in Table 8.2.

Table 8.2 Existing intersection performance

Intersection	AM peak		PM peak	
	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)
Throsby Street/Hannell Street	A	9	A	8
Honeysuckle Drive/Hannell Street	C	33	F	>70
Hunter Street/Stewart Avenue	F	> 70	E	55
King Street/Stewart Avenue	C	35	C	42
Hunter Street/Steel Street	A	10	A	14
King Street/Steel Street	B	18	D	52
Hunter Street/Union Street	B	25	C	30
King Street/Union Street	D	43	D	44
Hunter Street/Merewether Street	B	25	C	29
Hunter Street/Darby Street	C	31	B	25
King Street/Darby Street	B	28	B	26

Source: Newcastle Light Rail Paramics and SIDRA models (GHD, 2015)

The results indicate that:

- The following intersections operate with a level of service F:
 - intersection of Hunter Street/Stewart Avenue during the morning peak
 - intersection of Honeysuckle Drive/Hannell Street during the afternoon peak.
- All other intersections operate with an acceptable level of service.

8.2.3 On-street parking and loading zones

Streets in the study area are used for on-street car parking by residents, local customers and workers in the Newcastle city centre. Parking restrictions include a mixture of ticketed, time restricted (five, 15 and 30 minutes), designated railway, disabled, motorcycle, no stopping, unrestricted, bus and taxi zones, construction, and loading zones.

A kerbside parking audit was undertaken by GHD in October and November 2015 to determine the number, restrictions and length of all on-street parking spaces, bus zones and loading zones in the study area. The number of existing car parking and loading zones by street are summarised in Table 8.3.

Table 8.3 Existing on-street parking and loading zones in the study area

Street	Number of existing car and motorcycle spaces	Number of existing loading zone spaces
Argyle Street	15	2
Bellevue Street	10	0
Beresford Street	53	2
Centenary Road	41	3
Honeysuckle Drive	29	0
Hunter Street	181	29
King Street	111	4
Market Street	6	0
Merewether Street	0	0
Old Hannell Street	32	0
Scott Street	126	8
Station Street	29	0
Steel Street	11	0
Stewart Avenue	0	0
Telford Street	32	0
Watt Street	3	0
Worth Place	3	0
Total	682	48

8.2.4 Wider transport network

Local and regional buses

The local and regional bus network in Newcastle is currently serviced by five operators – Newcastle Buses and Ferries, Port Stephens Coaches, Hunter Valley Buses, Rover Coaches, and Busways. Interstate coaches that stop in Newcastle are operated by Greyhound Australia, Sidd Fogs, and Premier Motor Service.

Thirty Newcastle Buses routes currently operate along Hunter Street, with 10 stops in each direction between the Wickham Transport Interchange and the Newcastle bus interchange, located near Newcastle Station in Watt Street. Most of these buses and coaches terminate at the Newcastle bus interchange.

The interstate buses operate mainly to and from towns in the Hunter, Port Stephens and Mid-North Coast regions. Greyhound Australia services stop at Newcastle on their Brisbane to Sydney route. These buses travel along Hunter Street, stopping at the Newcastle bus interchange. About 60 interstate bus services terminate at the Newcastle bus interchange per day, with eight of these using it during the AM peak.

Pedestrians

Pedestrian traffic in and around the proposal site consists of:

- city workers and shoppers walking to and from their parked cars
- residents

- visitors and workers walking to and from bus stops.

There are eight at-grade crossings and six bridges across the former rail corridor. The at-grade crossings of the former rail corridor consist of those recently constructed at Steel Street, Kuwumi Place, Worth Place, Argyle Street, Perkins Street and Wolfe Street; and crossings associated with the Stewart Avenue/Hannell Street and Steel Street road crossings of the former rail corridor. These convey pedestrians in a north-south direction across the corridor, and link the Honeysuckle and wharf area to the CBD.

Two additional pedestrian crossings of the proposal site are located at Scott Street east of Newcastle Station.

The location of these crossings is shown on Figure 2.2.

East-west crossings for pedestrians are located at Stewart Avenue/Hunter Street and Hannell Street/Honeysuckle Drive.

Pedestrian access along the proposal site is provided by the footpaths on:

- Beresford Street on the southern side east of Stewart Avenue
- both sides of Hunter Street between east of Worth Place and Scott Street
- both sides of Scott Street between Perkins Street and Telford Street.

Cyclists

The following cycle lanes/paths are located in the study area:

- A narrow, bicycle lane (about 0.5 metres wide) is provided on Stewart Avenue/Hannell Street between Hunter Street and Honeysuckle Drive. However due to its narrow width and the large traffic volumes on this road, it is not heavily used.
- North of Honeysuckle Drive in Hannell Street via a foreshore shared path on the eastern side of Hannell Street.
- On-road bicycle lanes on both sides of Honeysuckle Drive between Hannell Street and Workshop Way.
- On-road mixed traffic environment on both sides of Workshop Way.
- On-road mixed traffic environment on the western side of Merewether Street north of the former rail corridor.
- On-road bicycle lanes on both sides of King Street between Stewart Avenue and Darby Street.
- On-road bicycle lanes in Auckland Street south of Hunter Street as part of the cycle route to the Fernleigh Track.
- A dedicated off-road shared pedestrian and cycle path along the foreshore between Hannell Street and Wharf Road.

Cyclists cross the former rail corridor using the at-grade pedestrian crossings.

8.3 Impact assessment

8.3.1 Construction

Traffic impacts

Vehicle movements

A summary of the estimated daily heavy vehicle movements for each construction zone is provided in Table 8.4. These movements would be distributed across the working period and would be managed in accordance with the construction traffic, transport and access management plan (refer to section 8.4.2) to minimise the potential for impacts on the existing road and transport network, and to ensure adequate levels of safety.

Table 8.4 Estimated daily heavy vehicle movements

Construction zone	Number of trucks per day
Zone 1: Railway corridor west of Worth Place	12
Zone 2: Hunter Street between Worth Place and Darby Street	9
Zone 3: Hunter Street east of Darby Street and Scott Street to Wolfe Street	9
Zone 4: Scott Street east of Wolfe Street	8
Total	38

Source: Light rail constructability assessment, September 2014

The delivery of some infrastructure components (such as roofing panels and beams for the stabling and maintenance facility, and substation components for the substations) may be oversized deliveries. These deliveries would be undertaken in accordance with the requirements of the relevant authorities, and may need to be undertaken outside of standard working hours.

The total number of light vehicle movements around the proposal site is estimated to be less than 20 vehicles per day. This is because construction workers would be encouraged to park at designated worker parking area/s or to use public transport, and workers and their equipment would be shuttled from the parking areas to work sites by private mini-buses. Other light vehicle trips would include supervisory staff and other ancillary requirements.

Overall, the total numbers of heavy and light vehicle movements on roads around the proposal site during construction would be low compared to the overall traffic volumes on these roads. Construction vehicle generation would not result in a substantial impact on local road capacity or the road network overall.

Impacts of the proposed construction methodology on Hunter Street

As noted in chapter 7, the proposed construction methodology involves undertaking construction on short sections (about 100 metres) of Hunter Street, where traffic flow would be reduced to one lane in each direction in the vicinity of the construction zone. To assess the potential impacts of this proposed methodology, a capacity analysis was undertaken on the section of Hunter Street between Steel Street and Union Street (because this section has the highest existing daily traffic volume). The results of the analysis indicate that, while there would be potential for a minor increase in the travel time, the overall level of service at intersections would not change. This indicates that, with appropriate construction traffic management, the impacts of reducing traffic movement along short sections of Hunter Street to one lane in each direction in the vicinity of the construction zone would be minimal.

Worker parking

Estimated construction workforce numbers are provided in section 7.3.2. To minimise potential impacts to city centre workers, residents and local businesses, designated construction workforce parking areas would be provided as noted in section 7.5.2. The contractor would provide a shuttle bus to transfer workers to and from the various work zones each day.

On-street parking and loading zones

Changes to existing on-street parking and loading zones would be required to provide sufficient width for construction, to maximise the width of traffic lanes available, and to enable the proposal to operate efficiently and safely. These changes would commence during the construction period. Section 8.3.2 outlines the changes as a result of the proposal.

If on-street parking and loading zones need to be removed for construction, and it is not intended to replace these following commencement of operations, they would remain unavailable following the completion of construction in that area. As such, parking and loading zones would be removed progressively along the proposal site during construction. This is proposed to limit unnecessary changes and uncertainty over parking availability.

Impacts to on-street parking and loading zones would be managed by implementation of the measures provided in section 8.4.

Wider transport network

There would be some repositioning of bus stops where they would conflict with construction works areas. In these situations, bus stops would be temporarily repositioned either 50 metres east or west of the proposed worksite to avoid the potential conflict.

The shuttle bus to and from Hamilton Station would continue to operate at least until the Wickham Transport Interchange opens. Further information is provided in section 7.5.5.

Heavy rail services to Hamilton Station would not be affected by the proposal.

Pedestrians and cyclists

Pedestrian movements along existing footpaths in the vicinity of the proposal site would be maintained for the majority of the construction period.

Pedestrian and cyclist access in the immediate vicinity of the proposal site would be largely maintained, however temporary diversions may be required around work areas and site access points. Further information is provided in section 7.5.7.

The main potential for impact to cyclists is where existing cycle routes need to be diverted and/or where conflicts occur, such as at site compound access points or, more generally, where cycle routes mix with local traffic, which may become more hazardous with the introduction of construction vehicles.

Potential impacts to pedestrians and cyclists would be managed by implementation of the measures provided in sections 8.4.

Emergency access

Access for emergency services vehicles would be maintained at construction sites, and measures to facilitate the movement of emergency vehicles would be defined in the traffic management plan for each worksite.

Emergency services would be consulted regarding proposed changes to traffic arrangements to identify any specific requirements which need to be incorporated into the construction traffic management plan.

Special events management

Construction hours and works may need to be adjusted during special events. The construction contractor would be responsible for incorporating special events into the works program and construction traffic management plan.

Traffic, transport and access management

Potential construction traffic impacts would be managed by the implementation of measures provided in sections 8.4 and 16.3. The specific measures would be confirmed by the appointed construction contractor when the construction method is confirmed. Any substantive changes to the preliminary construction methodology would require an analysis of potential traffic impacts and approval by TfNSW, along with any required mitigation measures.

8.3.2 Operation

The changes to the road and transport network (including changes to lane configuration, crossings and intersection arrangements) that form part of the proposal for the purpose of this REF are described in section 6.3.

Traffic impacts

The changes to road configuration on Hunter Street would result in a redistribution of traffic in the study area. The estimated daily traffic volumes on key roads in the vicinity of the proposal are provided in Table 8.5 for the existing situation (2015 – the year the modelling was undertaken), during operation of the proposal for the modelled year of opening (as noted in section 8.1, 2018 was the assumed year of opening for modelling purposes, and is equivalent to the actual predicted year of opening of 2019), and ten years after opening (2028). Further details of predicted changes to traffic volumes on these and other roads in the study area are provided in Appendix C of Technical Paper 1.

Table 8.5 Estimated daily traffic volumes on key streets

Location	Existing (2015)	Year of opening (2018) with the proposal	Ten years after opening (2028) with the proposal
Stewart Avenue - Hunter Street to Honeysuckle Drive	29,500	28,700	29,800
Steel Street - Hunter Street to Honeysuckle Drive	2,600 ¹	7,700	9,400
Hunter Street - Merewether Street to Darby Street	18,100	12,300	12,300
King Street - Auckland Street to Darby Street	12,500	20,100	20,400
Scott Street - Bolton Street to Watt Street	11,500	10,700	10,400

Note: Daily traffic volumes rounded to nearest 100 vehicles

1: There is no current connection between Hunter Street and Honeysuckle Drive along Steel Street. The 2015 traffic volumes are indicative of existing movements south of the former heavy rail corridor.

A separated light rail only lane in Hunter Street in each direction would remove an existing lane for vehicular traffic. Traffic volumes on Hunter Street are forecast to reduce substantially as a result. It is estimated that about 7,600 additional vehicles per day may divert onto King Street in 2018. The estimated increase in daily traffic volumes in 2028 is 300 vehicles greater than in 2018.

When operational, it is forecast that Steel Street between Hunter Street and Honeysuckle Drive would attract traffic.

Traffic volumes on Stewart Avenue and Scott Street would not change substantially from existing levels in either 2018 or 2028.

Potential operational traffic impacts would be managed by the implementation of the mitigation measures provided in section 8.4.

Key intersection performance

SIDRA intersection modelling was undertaken for the key intersections within the study area for the proposed year of opening (2018) and ten years after opening (2028) of the proposal. The performance of intersections was modelled with and without the operation of the proposal to assess the potential impacts of the proposal. The results of modelling are shown in Figure 8.2 and summarised in Table 8.6.

It is forecast that the key intersections at Honeysuckle Drive/Hannell Street and Hunter Street/Stewart Avenue would operate at a level of service F without the proposal. The intersections of King Street/Union Street and King Street/Stewart Avenue would operate at a level of service D in both the AM/PM peaks and the PM peak respectively.

With the proposal, the results of modelling indicate that the proposed connections across the former rail corridor (at Steel Street and Worth Place) would allow a redistribution of traffic in the western part of the study area. Initial indications are that the level of service is not significantly impacted, however further investigation is required to determine if individual intersections require adjustments.

With the proposal, it is forecast that the King Street/Stewart Avenue intersection would operate at a level of service D for both the AM and PM peak periods. At King Street/Union Street, a level of service E is forecast for the PM peak.

The results indicate that overall, with the proposal operating, the performance of key intersections in 2028 would be satisfactory.

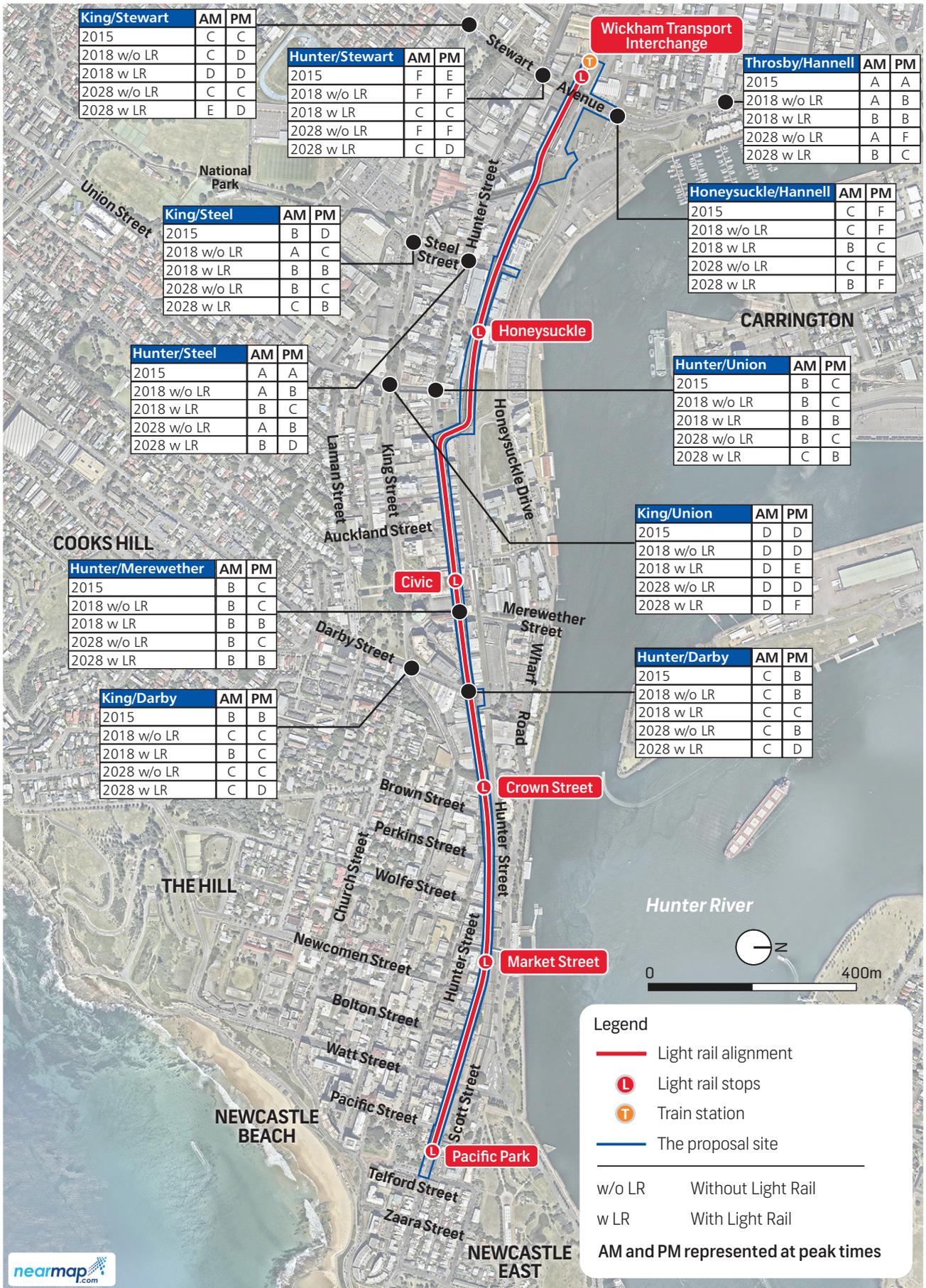


Figure 8.2 Intersection performance in 2018 and 2028 with and without the proposal

Table 8.6 Intersection performance in 2018 and 2028 with and without the proposal

Intersection	Existing LoS ¹ (2015)		LoS in 2018 without the proposal		LoS in 2018 with the proposal		LoS in 2028 without the proposal		LoS in 2028 with the proposal	
	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak
Throsby Street/Hannell Street	A	A	A	B	B	B	A	F	B	C
Honeysuckle Drive/Hannell Street	C	F	C	F	B	C	C	F	B	F
Hunter Street/Stewart Avenue	F	E	F	F	C	C	F	F	C	D
King Street/Stewart Avenue	C	C	C	D	D	D	C	C	E	D
Hunter Street/Steel Street	A	A	A	B	B	C	A	B	B	D
King Street/Steel Street	B	D	A	C	B	B	B	C	C	B
Hunter Street/Union Street	B	C	B	C	B	B	B	C	C	B
King Street/Union Street	D	D	D	D	D	E	D	D	D	F
Hunter Street/Merewether Street	B	C	B	C	B	B	B	C	B	B
Hunter Street/Darby Street	C	B	C	B	C	C	C	B	C	D
King Street/Darby Street	B	B	C	C	B	C	C	C	C	D

Note 1: LoS – level of service

2018 scenario – summary of results

The results indicate that without the proposal, intersection performance would be:

- similar to existing (2015) conditions in the AM peak period
- marginally worse at five intersections in the PM peak period.

2028 scenario – summary of results

With a further ten years of natural traffic growth as well as the effect of increased urban development and population in the Newcastle city centre, the modelling results indicate that intersection performance would be either similar or deteriorate slightly compared to the 2018 scenario. The results indicate that, with the proposal:

- The intersection of King Street/Stewart Avenue would operate at a level of service E in the AM peak period.
- The intersections of Honeysuckle Drive/Hannell Street and King Street/Union Street would operate at or near capacity (level of service F) in the PM peak period.

The intersection of Honeysuckle Drive/Hannell Street currently operates at a level of service F. Further investigation will be undertaken as part of the additional road improvements in section

6.3.4 to determine any further improvements to this intersection. The performance of the intersection at King Street/Union Street is impacted by the performance of the southern approach to this intersection. All other approaches operate with a satisfactory level of service.

Changes to on-street parking and loading zones

The proposal would reduce the availability of on-street car parking around the proposal site, mostly as a result of the need to provide space for the light rail alignment on Hunter and Scott streets. It would also impact on some existing loading zones.

A total of 267 on-street car parking spaces would need to be permanently removed. 182 of these spaces are in marked bays, and the remainder are unmarked spaces. 17 motorcycle parking spaces would also need to be removed from Steel and King streets.

In King Street, 83 on-street car parking spaces would be affected for part of the day by the proposed peak period 'No Stopping' zone – 27 spaces on the northern side of the street during the AM peak period, and 56 spaces on the southern side of the street during the PM peak period.

A total of 29 spaces in loading zones, including three mail zones, would need to be removed and potentially relocated to other streets in the city centre.

The locations of on-street parking spaces and loading zones that would need to be removed are shown on Figure 8.3.

As noted in section 8.4, options to mitigate the removal of on-street parking spaces and loading zones would be assessed by TfNSW. Options for replacement parking include the former rail corridor between Merewether Street and Argyle Street, and between Worth Place and west of Civic Place. The options assessment would include consultation with relevant stakeholders, including affected businesses, Roads and Maritime, and Council, and consideration of relevant transport and parking strategies and policies.

It is noted that the removal of the heavy rail line east of Stewart Avenue and the installation of new pedestrian crossings of the former rail corridor has improved access to some larger off-street paid car parking areas and parking located along the foreshore areas to the north of the former rail corridor.

Transport network impacts

A revised city centre bus plan would be developed for implementation by TfNSW. This plan would confirm which bus routes would operate in Hunter and Scott streets into the future.

The design for the proposal indicates that seven of the existing 20 bus stops in the vicinity of the proposal site would need to be removed or repositioned. Bus stops on Hunter Street west of Union Street, on Honeysuckle Drive west of Steel Street, and on King and Darby streets would not be impacted.

Once the Wickham Transport Interchange is operational, heavy rail services would terminate at the interchange. Passengers wishing to travel from the interchange to the Newcastle city centre would access light rail services via a short, covered walkway.

As noted in section 7.5.5, until the proposal is operational, the existing shuttle bus would continue to operate between Hamilton Station and the Newcastle city centre, with a new stop at the Wickham Transport Interchange. Buses for the Queens Wharf and Hunter Street Mall stop could use bus stops on either side of Wharf Road at the Queens Wharf ferry terminal.

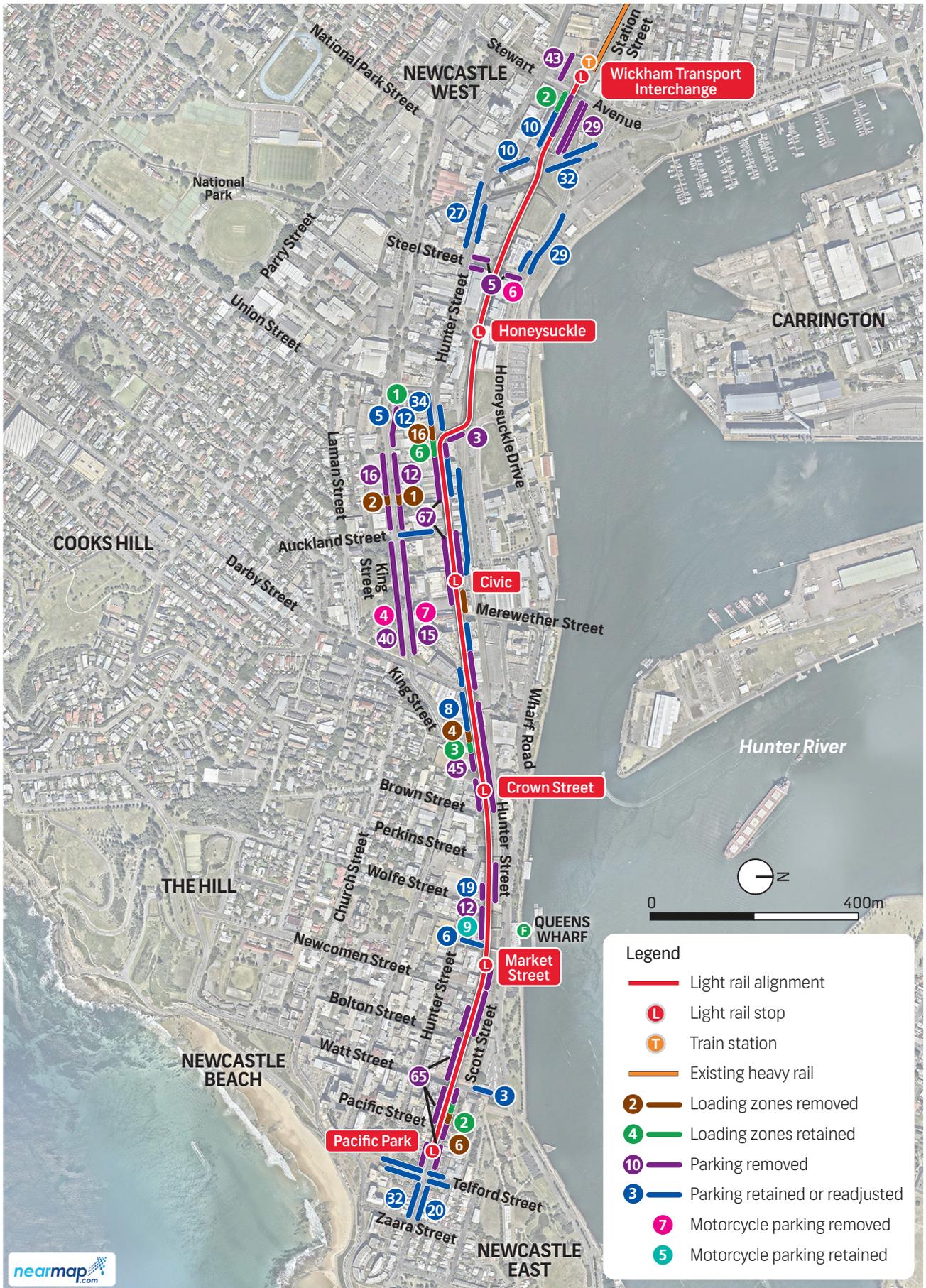


Figure 8.3 Changes to parking and loading zones with light rail operational

Existing taxi ranks in Hunter Street at Civic Station, and in Watt Street at Newcastle Station, may need to be relocated to provide space for a new development project at Civic and for a bus stop in Watt Street respectively. Consultation with Council and the taxi industry would be conducted to identify suitable locations for replacement taxi ranks.

Pedestrians

Access to the light rail stops

Proposed pedestrian access arrangements are summarised in section 6.3.2.

Crossings of the light rail tracks

Crossing locations would require clear visibility with appropriately designed wayfinding signage. All crossings would be designed to comply with the *Disability Standards for Accessible Public Transport 2002*.

The proposal involves removing the existing pedestrian bridge at Wickham Station. The bridge needs to be removed, along with other facilities on the site, to enable development of the stabling and maintenance facility. Pedestrian access would not be permitted through the stabling and maintenance facility. The alternate route for pedestrians would be via Beresford Street to Stewart Avenue and Honeysuckle Drive. This is about 270 metres longer than the existing pedestrian route via the pedestrian bridge. Pedestrians could alternatively walk between Honeysuckle Drive and Hunter Street via Steel Street.

The proposal involves removing the existing pedestrian bridge over the former rail corridor located to the west of Market Street. The alternate route for pedestrians is via Council's Market Street pedestrian bridge to Queens Wharf.

Access along the light rail alignment

As noted in section 6.2.2, a hedge or low fence would be installed along the light rail alignment within the former rail corridor to prevent/deter people from walking along the corridor. Existing fencing may be left in place where required for safety and security reasons.

Pedestrian access along the light rail alignment would not be allowed between:

- Bellevue Street/Hannell Street at the existing location of Wickham Station and Steel Street along the former rail corridor.
- Steel Street and the Honeysuckle pedestrian crossing at Kuwumi Place.
- The eastern end of the Honeysuckle stop and Worth Place.

Cyclists

Cyclists using Hunter and Scott streets could informally cross the light rail tracks in the roadway at a number of locations. A potential safety risk for cyclists travelling in the street parallel to the light rail alignment is that bicycle tyres could become caught in the grooves of light rail tracks. The installation of light rail signals and pedestrian crossings connecting to light rail stops may also present additional risks for cyclists and make these routes less attractive. Alternative east–west cyclist routes are along Honeysuckle Drive and Wharf Road, although depending on the destination, these may be less desirable.

The existing bicycle lane along both sides of King Street would be affected by the proposed peak period 'No Stopping' zone, which would apply on the north side in the AM peak and on the south side in the PM peak on weekdays. As noted in section 8.4, a review of options to support the provision of a dedicated east–west cycleway, potentially replacing the existing cycleway along King Street, would be undertaken.

8.3.3 Cumulative impacts

Some construction work for the Wickham Transport Interchange and the proposal would coincide, as the interchange is scheduled to be operational in 2017, and construction of the proposal is predicted to commence in early 2019. There would be a period of about six to 12 months when both projects are under construction concurrently. Potential cumulative impacts on the road network in the Wickham and Newcastle West areas may result, in particular along Stewart Avenue, Hannell Street and Honeysuckle Drive.

With most of the construction activities for the two projects located on either the west or east sides of Stewart Avenue, cumulative impacts during the construction phase are likely to be minimal for traffic, and for pedestrians and cyclists passing near the construction zone.

To reduce the potential for cumulative traffic impacts, heavy vehicle movements in the Wickham area, and in Stewart Avenue and Hannell Street, would be restricted to outside of the weekday peak hours. A key strategy would also be regular liaison between the lead contractors, particularly for works involving Stewart Avenue/Hannell Street.

There would be a cumulative reduction in on-street car parking spaces as a result of the proposal together with the Wickham Transport Interchange project. The cumulative reduction of on-street car parking spaces, including the 75 car parking spaces removed to construct and operate the Wickham Transport Interchange project, would be 342 spaces.

As noted in section 8.4, options to mitigate the removal of on-street parking spaces and loading zones would be assessed.

8.4 Mitigation measures

8.4.1 Detailed design and pre-construction

- A parking strategy would be prepared prior to construction to review options to mitigate the loss of on-street parking and loading zones. The review would include both existing on-street and off-street parking locations as well as the opportunities provided by new or proposed developments or Government-owned land close to the proposal site. The review would:
 - be undertaken in accordance with the objectives and requirements of the Newcastle Urban Renewal Strategy and the NUTTP, and relevant transport and parking strategies and policies
 - involve an audit of the use of existing spaces including turnover
 - include an assessment of the potential options and identification of a preferred option/s
 - be undertaken in consultation with relevant stakeholders, including surrounding businesses/organisations and Council.
- A cycleway strategy would be prepared prior to construction to review options available to support the provision of a dedicated east–west cycleway, potentially replacing the existing cycleway along King Street. The review would include assessment of potential options and identification of a preferred option/s, and would be undertaken in consultation with relevant stakeholders, including Council, Roads and Maritime and local cyclist groups.
- The agreed package of measures to complement the introduction of the proposal; remove existing pinch points in the road network; and ensure traffic continues to move freely and efficiently during construction and operation, would be determined in consultation with Council.

8.4.2 Construction

- A construction traffic, transport and access management plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to minimise the potential impacts on traffic, transport and access. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.
- Consultation with relevant stakeholders would be undertaken regularly to facilitate the efficient delivery of the works and to minimise congestion and inconvenience to road users. Stakeholders would include contractors on adjacent work sites (particularly the Wickham Transport Interchange) and others such as Council, bus operators, Roads and Maritime, emergency services, affected businesses, and other relevant organisations (such as the University of Newcastle and major employers in the city centre).

9. Noise and vibration

A noise and vibration assessment of the proposal was undertaken by GHD. A comprehensive technical report is available as 'Technical Paper 2 – Noise and Vibration Assessment' on the TfNSW website (www.transport.nsw.gov.au). A summary of the assessment is provided in the following sections.

9.1 Assessment approach and methodology

The assessment involved:

- Establishing noise and vibration criteria and management levels to:
 - provide a basis for assessing the potential for impacts during construction
 - provide a basis for assessing the potential for impacts during operation, based on the current design, and establish the levels that will be used to refine the design during future design stages
 - use as the basis for monitoring during construction and operation.
- Identifying key areas of potential impact during construction and providing guidance for the development of reasonable and feasible measures to minimise the potential significance of impacts, particularly in relation to noise experienced by sensitive receivers, and the impacts of vibration on heritage items and other sensitive land uses.
- Confirming whether additional operational mitigation is required. This assessment provides the first step in assessing the potential for the proposal to cause noise impacts during operation. It is noted that the assessment summarised in this chapter and presented in Technical Paper 2 is only the first stage in the operational noise and vibration assessment for the proposal. This assessment indicates the potential for exceedances based on the pre-concept design, and it informs the detailed design stage by providing guidance and options for refining the design to reduce the exceedances identified.

A summary of the main steps involved in the assessment is provided in the following sections. Further information is provided in Technical Paper 2.

9.1.1 Identification of noise sensitive receivers and noise catchment areas

Potentially sensitive receivers are those that may be affected by changes in noise and vibration levels. Noise and vibration sensitive receivers were identified based on the type of use, the activities undertaken and the nature of the building.

Noise catchment areas are areas that are likely to have similar noise exposures on the basis of factors such as topography, land uses, setbacks and types of residences or other noise receptors. Eight representative noise catchment areas (NCAs) were identified for the assessment. Sensitive receivers are summarised in section 9.2.

9.1.2 Measuring background noise to determine existing noise levels

Background noise monitoring was undertaken to establish the representative background noise environment across each NCA, which is represented by the 'Rating Background Level' (RBL) for each NCA. Background noise, described by the RBL, is the underlying level of noise present in an area once transient and short-term noise events are filtered out.

The background noise monitoring undertaken for the assessment is described in section 9.2.1.

9.1.3 Establish noise and vibration management levels and criteria

Noise and vibration management levels and criteria were established to provide a basis for this assessment and future design refinements. The guidelines and policies used to develop the management levels and criteria are listed below. The management levels and criteria are summarised in section 9.3.

Noise

Construction noise management levels

The *Interim Construction Noise Guideline* (DECC, 2009) establishes noise management levels according to the hours in which construction is expected to take place. The recommended standard hours for construction are:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- no work on Sundays or Public Holidays.

For work during recommended standard hours:

- The 'noise affected level' represents the point above which there may be some community reaction to noise. It is calculated by adding 10 dB(A) to the RBL.
- The 'highly noise affected level' represents the point above which there may be strong community reaction to noise. This noise level is considered to be 75 dB(A).

The *NSW Road Noise Policy* (DECCW, 2011) was used to assess construction traffic noise. The policy provides target levels for residential receivers in the vicinity of existing roads.

Operation noise

Potential operational noise emissions are divided into two main categories:

- Noise emissions due to the operation of light rail vehicles, which is assessed using the *Rail Infrastructure Noise Guideline* (the RING) (EPA, 2013) (potential noise sources are identified in section 9.4.2).
- Stationary and ancillary noise sources which are assessed using the *NSW Industrial Noise Policy* (EPA, 2000). This comprises noise emissions from light rail stops, substations and the stabling and maintenance facility.

Airborne noise is noise that reaches a receiver through the air. Groundborne noise is transmitted as vibration through the ground and into structures, and then radiated as low frequency 'rumble' noise.

Operational (airborne) noise goals were derived from the RING. If triggered, the operational noise assessment is required to address the potential noise impacts and consider possible mitigation measures that may be feasibly and reasonably applied to mitigate the impacts.

The groundborne noise trigger levels in the RING were also used. Groundborne noise is generally only a potential issue where noise levels are higher than the airborne noise levels, such as for underground railways. As there are no underground sections associated with the proposal, the risk of potential adverse groundborne noise impacts is considered low.

The *Environmental Management System Guide: Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) provides guidance on the assessment of sleep disturbance based on the *Industrial Noise Policy*.

Vibration

Vibration was assessed based on the criteria provided in *Assessing Vibration: A Technical Guideline* (DEC, 2006). This guideline recognises the *British Standard (BS) 6472:1992 - Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)* as the preferred standard for assessing human comfort criteria.

The *Construction Noise Strategy* (TfNSW, 2012) recommends the use of *BS 7385-2:1993 Evaluation and measurement for vibration in buildings* for establishing cosmetic damage guideline criteria. However, for this assessment, the German Standard *DIN 4150-3:1999 Structural vibration - Effects of vibration on structures* has been applied, as it is more stringent.

Reference was also made to *BS 5228-2:2009 - Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*.

9.1.4 Assess the potential noise and vibration impacts of the proposal and Identify feasible and reasonable mitigation and management measures

Noise modelling was undertaken using the computer aided noise abatement (CadnaA) model. Construction and operational noise predictions were undertaken using CadnaA, and vibration calculations were also undertaken.

Once the background noise levels and the management levels/criteria were determined, the predicted noise and vibration levels were compared with the relevant criteria to identify potential impacts. The results of the impact assessment are summarised in 9.4.

Mitigation and management measures are provided to avoid or reduce identified impacts. These include standard measures which have been used on other similar projects and shown to be efficient and effective in reducing impacts and risks associated with similar works. They also include additional specific mitigation and management measures which would need to be refined and reviewed as the design progresses to determine whether they are reasonable and feasible in accordance with the RING, and following community and stakeholder input. Mitigation and management measures are summarised in section 9.5.

9.2 Existing environment

9.2.1 Noise catchment areas and background noise monitoring

The NCAs are shown in Figure 9.1 and listed in Table 9.1. Monitoring was undertaken at seven locations between 28 November and 15 December 2014. Noise monitoring data obtained during May 2014 as part of the noise and vibration assessment for the Wickham Transport Interchange Review of Environmental Factors (GHD, 2014c) was used to supplement the noise monitoring results at the western end of the proposal site. Noise monitoring locations are shown in Figure 9.1 and listed in Table 9.1.

Detailed noise monitoring results and charts are provided in Technical Paper 2.

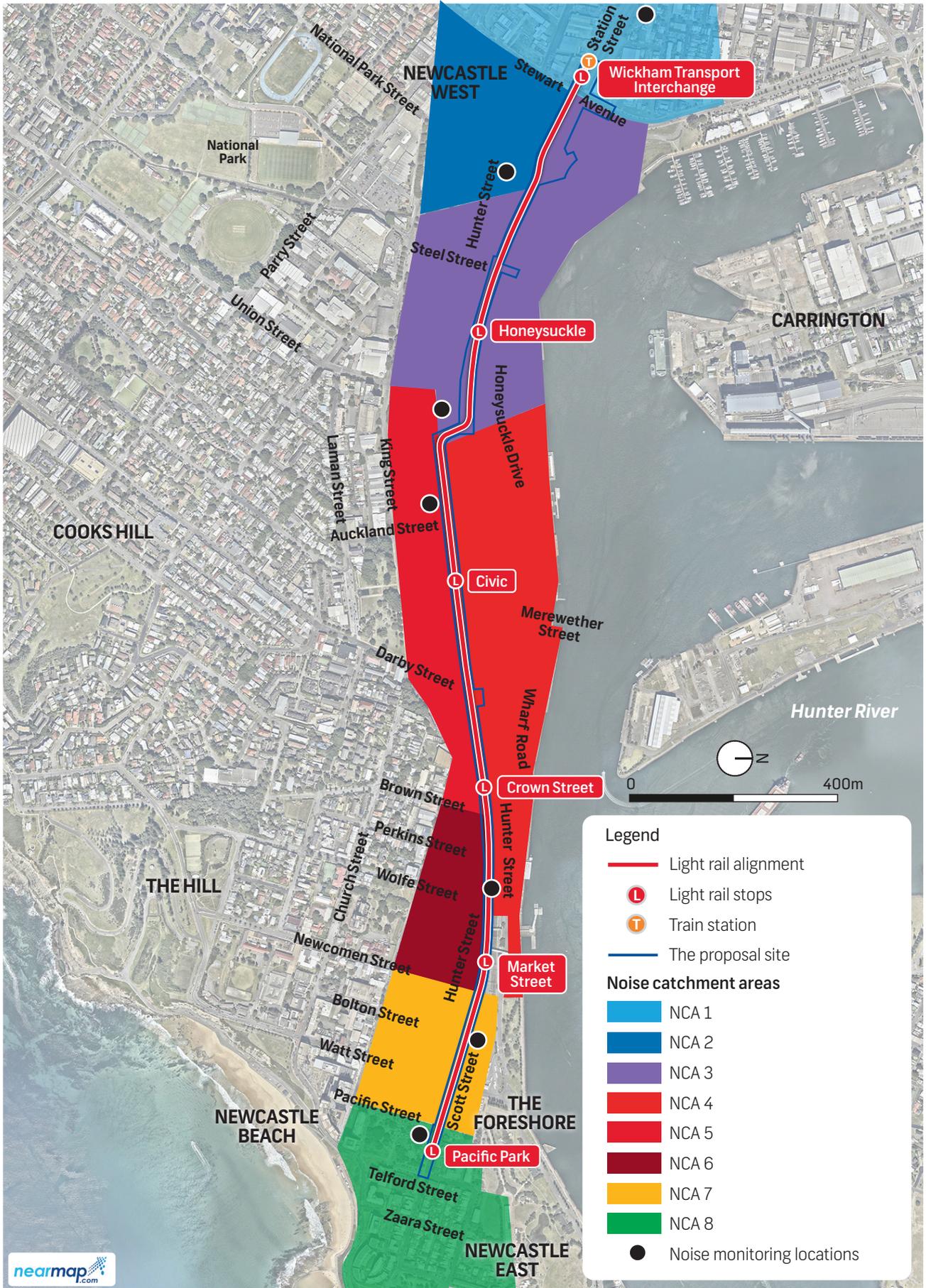


Figure 9.1 Location of noise catchment areas and baseline monitoring locations

Table 9.1 Noise catchment areas and noise logger locations

NCA	Number of Identified residential receivers	Description of existing main noise sources	Noise logger location
NCA 1	16	Heavy rail noise, road traffic noise, various commercial and industrial noises primarily during daytime hours	A ¹ 43a Station Street
NCA 2	17	Road traffic noise on Hunter Street and Stewart Avenue	L1 754 Hunter Street
NCA 3	26	Road traffic noise on Hunter Street, Honeysuckle Drive and Stewart Avenue	L2 Old Police station (554 Hunter Street)
NCA 4	10	Road traffic noise on Hunter Street, Honeysuckle Drive and Wharf Road	L4 414 Hunter Street
NCA 5	28	Road traffic noise on Hunter Street and King Street	L3, L4 L3 - 437 Hunter Street
NCA 6	16	Road traffic noise on Hunter Street and King Street	L5 Rail corridor west of Queens Brewery
NCA 7	28	Road traffic noise on numerous streets	L6 Newcastle Station (Scott Street)
NCA 8	120	Road traffic noise on numerous streets and surf noise on occasions, general recreational activities	L7 Joy Cummins Centre (corner of Scott and Pacific Street)

Note 1: Logger A - location from NCA5 in Wickham Transport Interchange Noise and Vibration Assessment (GHD, 2014c).

9.2.2 Vibration sensitive locations

Vibration sensitive locations are structures or land uses that could be affected by vibration. These could include heritage listed buildings/items, precision laboratories or operating theatres. Heritage listed buildings and items within and in the vicinity of the proposal site are listed in section 10.2. Other vibration sensitive receivers located within 100 metres of the proposal site are listed in Table 9.2.

Table 9.2 Vibration sensitive receivers within 100 metres (non-heritage listed)

Receiver	Address	Approximate distance to the proposal site (m)
Pathology Laboratory	780 Hunter Street, Newcastle West	40
Hunter Street Medical Centre	802 Hunter Street, Newcastle West	45
Hunter Radiology	1/710 Hunter Street, Newcastle West	20
Newcastle Community Health Centre / Hunter Area Pathology Service	670 Hunter Street, Newcastle West	10
The Face Place (Laser surgery)	368-370 King Street, Newcastle	50
Medibank Health Solutions	13 Darby Street, Newcastle	60
Australian Institute of Eye Surgery	110 Hunter Street, Newcastle	70
Newcastle Skin Cancer Clinic	14 Bolton Street, Newcastle	50

Receiver	Address	Approximate distance to the proposal site (m)
Neurologist	16 Telford Street, Newcastle	85

9.3 Noise and vibration management levels/criteria

A summary of the assessment management levels and criteria developed for the proposal based on consideration of the guidelines listed in section 9.1.3 is provided in the following tables. Table 9.3 and Table 9.4 provide the construction and operation noise management levels and criteria for the proposal. Table 9.5, Table 9.6 and Table 9.7 provide the vibration criteria for human comfort and structural damage. Safe working buffer distances to comply with the human comfort and structural damage criteria are presented in Table 9.8.

Further information on how the criteria were derived is provided in Technical Paper 2.

Table 9.3 Construction noise management levels

Noise catchment area	Construction noise management level, $L_{Aeq}(15min)$ (dB(A))			
	During standard recommended hours ¹		Outside of standard recommended hours ¹	
	Noise affected	Highly noise affected	Period 1 Mon-Fri (6 pm-10 pm), Sat (7 am-10 pm) and Sun/Pub Hol (8 am-6 pm)	Period 2 Mon-Fri (10 pm-7 am), Sat (10 pm-7 am) and Sun/Pub Hol (6 pm-8 am)
NCA 1	50	75	45	43
NCA 2	61	75	54	47
NCA 3	69	75	60	48
NCA 4	68	75	61	52
NCA 5	67	75	60	55
NCA 6	67	75	60	54
NCA 7	65	75	60	57
NCA 8	58	75	52	47

Note 1: Refer definitions in section 9.1.3

Table 9.4 Operational noise criteria

Receiver	Time period	Amenity criteria (acceptable noise level) ^{1,2} $L_{Aeq}(period)$	RBL $L_{A90}(15min)$	Intrusive criteria $L_{Aeq}(15min)$	Proposal specific noise criteria (external) $L_{Aeq}(15min)$	Sleep disturbance screening test (external) L_{Amax}
NCA 1 ³	Day	55	40	45	45	-
	Evening	45	40	45	45	-
	Night	40	38	43	40	53
NCA 2	Day	60	51	56	56	-
	Evening	50	49	54	50	-
	Night	45	42	47	45	57

Receiver	Time period	Amenity criteria (acceptable noise level) ^{1,2} L _{Aeq(period)}	RBL L _{A90(15min)}	Intrusive criteria L _{Aeq(15min)}	Proposal specific noise criteria (external) L _{Aeq(15min)}	Sleep disturbance screening test (external) L _{Amax}
NCA 3	Day	60	59	64	60	-
	Evening	50	55	60	50	-
	Night	45	43	48	45	58
NCA 4	Day	60	58	63	60	-
	Evening	50	56	61	50	-
	Night	45	47	52	45	62
NCA 5	Day	60	57	62	60	-
	Evening	50	55	60	50	-
	Night	45	50	55	45	65
NCA 6	Day	60	57	62	60	-
	Evening	50	55	60	50	-
	Night	45	49	54	45	64
NCA 7	Day	60	55	60	60	-
	Evening	50	55	60	50	-
	Night	45	52	57	45	67
NCA 8	Day	60	48	53	53	-
	Evening	50	47	52	50	-
	Night	45	42	47	45	57
Health/ Education	When in use	55 (external)	-	-	55 L_{Aeq(period)}	-
Commercial premises	When in use	65 (external)	-	-	65 L_{Aeq(period)}	-
Industrial premises	When in use	70 (external)	-	-	70 L_{Aeq(period)}	-

Note 1: The identified residential receivers have been classified as 'suburban' under the Industrial Noise Policy (EPA, 2000).

Note 2: There were no significant industrial noise sources in the study area therefore no adjustments have been applied to the proposal.

Note 3: NCA 1 has been categorised as 'suburban', whilst the remainder of the NCAs have been categorised as 'urban' based on exposure to traffic noise and general urban activities (RING, EPA 2013).

Table 9.5 Human comfort intermittent vibration limits (BS 6472:1992)

Receiver type	Period ¹	Intermittent vibration dose value (m/s ^{1.75})	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institutes	When in use	0.4	0.8

Note 1: Day is between 7 am and 10 pm and night is between 10 pm and 7 am

Table 9.6 Guidance on effects of vibration levels for human comfort (BS 5228:2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

Table 9.7 Guideline values for short term vibration on structures (DIN 4150-3:1999)

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under the above descriptions, and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

Note 1: At frequencies above 100 Hz the values given in this column may be used as minimum values.

Table 9.8 Vibration buffer distances

Activity	Human comfort buffer distance (m)	Structural damage buffer distances (m)	
		Heritage building/structure	Standard structure
10 tonne vibratory roller	66	27	18
Jackhammer ¹	Avoid contact with structure	2 (nominal)	1 (nominal)

Activity	Human comfort buffer distance (m)	Structural damage buffer distances (m)	
		Heritage building/ structure	Standard structure
Excavator	18	8	5
Piling (bored) ¹	N/A	4 (nominal)	2 (nominal)
Dozer	25	10	6

Note 1: These distances have been sourced from the *Construction Noise Strategy* (TfNSW, 2012)

9.4 Impact assessment

9.4.1 Construction

Construction noise

Construction typically requires the use of heavy machinery which can generate high noise and vibration levels at nearby receptors. At any location, the potential impacts may vary greatly depending on factors such as the proximity of sensitive receivers, the duration of works, the magnitude of the noise levels, the time at which the construction is undertaken, and the character of the noise or vibration emissions.

Noise levels have been predicted using computer modelling software based on the preliminary list of plant and equipment and an assumed construction methodology (summarised in chapter 7).

In accordance with the assessment guidelines, the potential noise impacts have been predicted with a focus on those activities with the highest potential to cause noise impacts, and assuming that the loudest plant for each activity is operating continuously. It is therefore expected that the predictions identify worst case noise levels, which may not be reached or only infrequently reached during the construction period. Generally, plant and equipment would not need to be running at full power all the time, and at other times may be idling or even switched off. The other key consideration with the proposal is that construction would progress from west to east along the route, at a rate of about 50 metres per month. Therefore, noise impacts would be experienced for a relatively short time at most locations.

The prediction results are summarised in Table 9.9.

Table 9.9 Predicted construction noise impacts at residential receivers

NCA	Noise management levels (from Table 9.3)		Range of potential exceedance of the noise management levels across receivers in the NCA (dB(A))				
			Removal/ early works	Works at stops	Stabling/ maintenance facility works	Civil works	Track installation works
NCA1	Highly affected	75	-	-	-	-	-
	Noise affected	50	0 to 11	0 to 19	0 to 2	1 to 25	0 to 22
	Out of hrs period 1	45	0 to 16	0 to 24	0 to 7	6 to 30	3 to 27
	Out of hrs period 2	43	0 to 18	1 to 26	0 to 9	8 to 32	5 to 29
NCA2	Highly affected	75	0 to 4	-	-	0 to 17	0 to 14

NCA	Noise management levels (from Table 9.3)		Range of potential exceedance of the noise management levels across receivers in the NCA (dB(A))				
			Removal/early works	Works at stops	Stabling/maintenance facility works	Civil works	Track installation works
	Standard hours	61	0 to 18	0 to 4	0 to 14	0 to 31	0 to 28
	Out of hrs period 1	54	0 to 25	0 to 11	0 to 21	1 to 38	0 to 35
	Out of hrs period 2	47	0 to 32	0 to 18	0 to 28	8 to 45	5 to 42
NCA3	Highly affected	75	-	-	-	0 to 16	0 to 13
	Standard hours	69	-	-	-	0 to 22	0 to 19
	Out of hrs period 1	60	-	0 to 8	-	0 to 31	0 to 28
	Out of hrs period 2	48	0 to 4	0 to 20	0 to 6	0 to 43	0 to 40
NCA4	Highly affected	75	-	-	-	0 to 18	0 to 15
	Standard hours	68	-	-	-	6 to 25	3 to 22
	Out of hrs period 1	61	-	0 to 4	-	13 to 32	10 to 29
	Out of hrs period 2	52	0 to 1	0 to 13	-	22 to 41	19 to 38
NCA5	Highly affected	75	-	0 to 16	-	0 to 19	0 to 16
	Standard hours	67	-	0 to 24	-	3 to 27	0 to 24
	Out of hrs period 1	60	-	0 to 31	-	10 to 34	7 to 31
	Out of hrs period 2	55	0 to 1	0 to 36	-	15 to 39	12 to 36
NCA6	Highly affected	75	-	0 to 7	-	2 to 19	0 to 16
	Standard hours	67	0 to 3	0 to 15	-	10 to 27	7 to 24
	Out of hrs period 1	60	0 to 10	0 to 22	-	17 to 34	14 to 31
	Out of hrs period 2	54	0 to 16	0 to 28	-	23 to 40	20 to 37
NCA7	Highly affected	75	-	0 to 1	-	0 to 18	0 to 15
	Standard hours	65	0 to 9	0 to 11	-	0 to 28	0 to 25
	Out of hrs period 1	60	0 to 14	0 to 16	-	2 to 33	0 to 30
	Out of hrs period 2	57	0 to 17	0 to 19	-	5 to 36	2 to 33
NCA8	Highly affected	75	-	0 to 8	-	0 to 17	0 to 14
	Standard hours	58	-	0 to 25	-	0 to 34	0 to 31
	Out of hrs period 1	52	0 to 6	0 to 31	-	0 to 40	0 to 37
	Out of hrs period 2	75	0 to 11	0 to 36	-	0 to 45	0 to 42

Based on a worst case assessment approach, the results presented in Table 9.9 indicate that it is likely that noise generated by construction activities would impact surrounding sensitive residential receivers, and potentially non-residential receivers, subject to further investigation of building façade acoustic performance. The impacts would be even greater if activities were to be undertaken outside of standard construction hours due to the lower criteria at these times.

While construction works would be transient and would affect individual receivers for a limited time only, certain activities, in particular concrete sawing, rail grinding, earthworks and track laying, have the potential to exceed the noise assessment criteria at the nearest sensitive receivers within all NCAs. It is also likely that the out of hours work would generate exceedances in all NCAs. The highly affected noise level of 75 dB(A), which applies for day and

night-time works, may also be exceeded for residences located in all NCAs, but particularly for receivers near to the proposal site where earthworks and track installation would take place.

Standard noise mitigation measures would therefore be implemented in accordance with TfNSW's *Construction Noise Strategy* as well as additional measures where feasible and reasonable. These measures would be detailed in the construction noise and vibration plan for the proposal, as described in sections 9.5 and 16.3.

There is the potential for sleep disturbance impacts during out of hours work. Further assessment and mitigation would be considered, once a construction contractor is appointed and a preferred construction method is known. This assessment would be undertaken to determine compliance with sleep disturbance criteria and any additional mitigation that may be required.

Construction traffic noise

Construction would result in an estimated 0.5 per cent increase in the volumes of heavy vehicles travelling on the road network, which would be spread across the working day. This increase would not contribute to any noticeable noise levels increases. As the increase in noise levels is predicted to be within two dB(A) of the current noise levels, the objectives of the *NSW Road Noise Policy* (DECCW, 2011) are achieved and no mitigation measures for construction traffic noise are required.

Construction vibration

Typical vibration generating activities during construction would include:

- general earthworks
- site clearing and demolition works
- bulldozers and excavators
- concrete breaking/removal
- ground compaction.

Due to a number of site specific factors (eg ground type and topography), there is inherent variability in ground vibration predictions without site-specific measurement data. Given this, the *Construction Noise Strategy* (TfNSW, 2012) provides indicative safe working distances for vibration intensive activities.

Theoretical safe working buffer distances to comply with the human comfort and structural damage criteria were calculated and are presented in Table 9.8. Potentially vibration sensitive receivers are situated within the recommended vibration buffer distances along the length of the proposal site, particularly along Hunter and Scott streets. Based on the assumed plant and equipment used in the noise and vibration assessment, there is potential for vibration generating construction activities and plant operating within the recommended buffer distances outlined in section 9.3.

Structural damage

Table 3-2 and 3-3 in Technical Paper 2 list nine vibration-sensitive land uses within 100 metres and 40 heritage structures within 50 metres of the proposal site respectively. There is one vibration-sensitive land use and 24 heritage listed structures/buildings within 10 metres of the proposal site. Subject to confirming the proposed plant and equipment to be used and the specific sensitivity of each site, there is potential that these buildings may be impacted by the works.

If inadequately managed, the use of heavy machinery, such as bored piling, dozer, excavator and breaker, has the potential to cause impacts to heritage buildings within the buffer distances shown in Table 9.8.

Piling works are only proposed to be undertaken at the maintenance and stabling facility which is remote from heritage structures and is therefore unlikely to result in impacts.

The mitigation measures listed in section 9.5 would be implemented to minimise the potential for vibration impacts to structures.

Human comfort

Humans are capable of detecting vibration at levels that are well below those causing risk of damage to a building. Guidelines are therefore set in terms of the levels that would result in minimum adverse comment by building occupants.

There is potential for works to be undertaken within the nominal buffer areas outlined in Table 9.8 and thus potential for impacts on human comfort. Human comfort impacts are likely to be short-term as the works would move progressively along the proposal site, and where possible, would be scheduled during standard construction hours.

The potential for impacts would be managed by implementing the mitigation measures provided in section 9.5.

Cumulative impacts

There is the potential for cumulative construction noise and vibration impacts due to the overlapping construction programs and proximity of other projects, particularly construction of the Wickham Transport Interchange. Receivers in NCA 1 and NCA 2 may experience construction noise from both projects either simultaneously or consecutively, depending on final construction timeframes. However, it is noted that traffic from Hannell Street/Stewart Avenue is also a dominant source of noise to many receivers at this location. At this stage, sufficient information is not available to quantitatively assess cumulative noise and vibration impacts. Cumulative construction noise and vibration impacts and corresponding mitigation measures would need to be considered during preparation of the construction noise and vibration management plan for the proposal.

9.4.2 Operation

Potential operational noise and vibration impacts were considered in relation to the following:

- noise generated by the operation of light rail vehicles
- noise from operation of stationary infrastructure
- operational vibration (vibration caused through the normal operation of the proposal)
- road traffic noise.

Noise generated by the operation of light rail vehicles

Potential noise sources

The operation of light rail vehicles can generate noise as a result of a combination of:

- noise emissions at the wheel-rail interface, including from the track
- noise from ancillary plant, for example drive motors and air conditioning
- warning bells.

Results of noise modelling

Detailed noise modelling was undertaken, including consideration of speed, service frequency and braking. Table 9.10 presents a summary of the operational noise level ranges compared with the RING noise criteria for each NCA, and indicates the predicted number of exceedances.

Table 9.10 Light rail operational noise levels at nearby receivers

Receiver			Range of predicted noise levels (dB(A))			Number of exceedances		
NCA	Receiver type	Number of Receivers	L _{Aeq} day	L _{Aeq} night	L _{Amax}	Day	Night	Maximum noise levels (residential only)
NCA1	Residential	16	26 to 47	21 to 42	38 to 60	-	-	-
	Commercial	19	27 to 51	23 to 47	40 to 63	-	-	-
	Industrial	19	26 to 42	21 to 38	38 to 48	-	-	-
NCA2	Residential	17	34 to 72	30 to 68	47 to 96	4	10	4
	Commercial	59	31 to 68	26 to 63	43 to 89	-	-	-
	Hospital	2	39 to 40	34 to 35	56 to 56	-	-	-
NCA3	Residential	29	31 to 61	26 to 56	36 to 81	1	5	1
	Commercial	94	28 to 65	23 to 60	35 to 85	-	-	-
	Hospital	8	51 to 61	46 to 56	61 to 77	8	-	-
	Educational/Worship	7	53 to 61	48 to 57	65 to 76	7	-	-
NCA4	Residential	10	52 to 59	47 to 54	64 to 77	-	6	-
	Commercial	78	42 to 62	37 to 57	51 to 79	-	-	-
	Educational/Worship	2	56 to 57	52 to 52	70 to 71	2	-	-
NCA5	Residential	28	29 to 59	24 to 54	38 to 76	-	23	-
	Commercial	91	29 to 60	24 to 55	37 to 77	-	-	-
NCA6	Residential	16	43 to 61	38 to 56	58 to 81	2	14	3
	Commercial	28	43 to 60	38 to 56	55 to 79	-	-	-
NCA7	Residential	28	31 to 61	26 to 56	45 to 80	1	17	1
	Commercial	12	28 to 62	23 to 57	37 to 83	-	-	-
NCA8	Residential	120	20 to 57	16 to 52	28 to 68	-	6	-
	Commercial	3	23 to 46	18 to 41	31 to 54	-	-	-
	Hospital	2	56 to 56	51 to 51	66 to 66	2	-	-

The predicted noise levels shown in Table 9.10 demonstrate that, during the daytime, the proposal would comply with the RING trigger levels at the majority of receivers. However, exceedances are predicted at about eight residential receivers located closest to the proposal site in NCA2, NCA3, NCA6, and NCA7.

There is also potential for daytime operational noise levels to exceed the internal trigger levels for non-residential receivers in NCA3, NCA4 and NCA8. Predictions indicate that, based on the concept design, exceedances could occur at about 19 receivers. However, it is noted that at this preliminary stage of the design, predictions were made at the external façade only. During the

detailed design phase, further investigation of the façade attenuation performance and specific building use is needed to identify whether mitigation measures would be required.

The indicative locations of daytime exceedances are shown in Figure 9.2 with night-time exceedances shown in Figure 9.3.

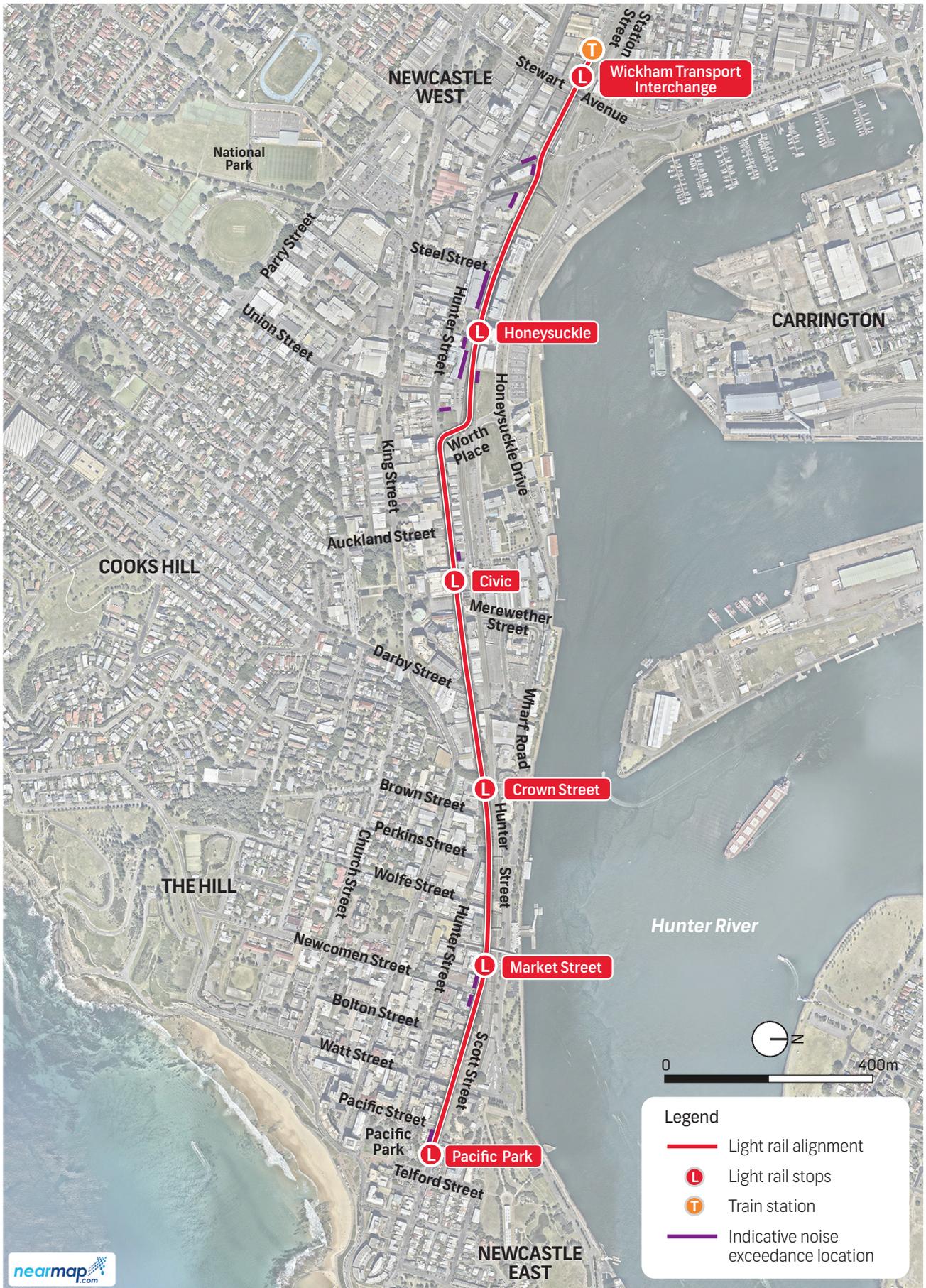


Figure 9.2 Indicative location of day-time noise exceedances

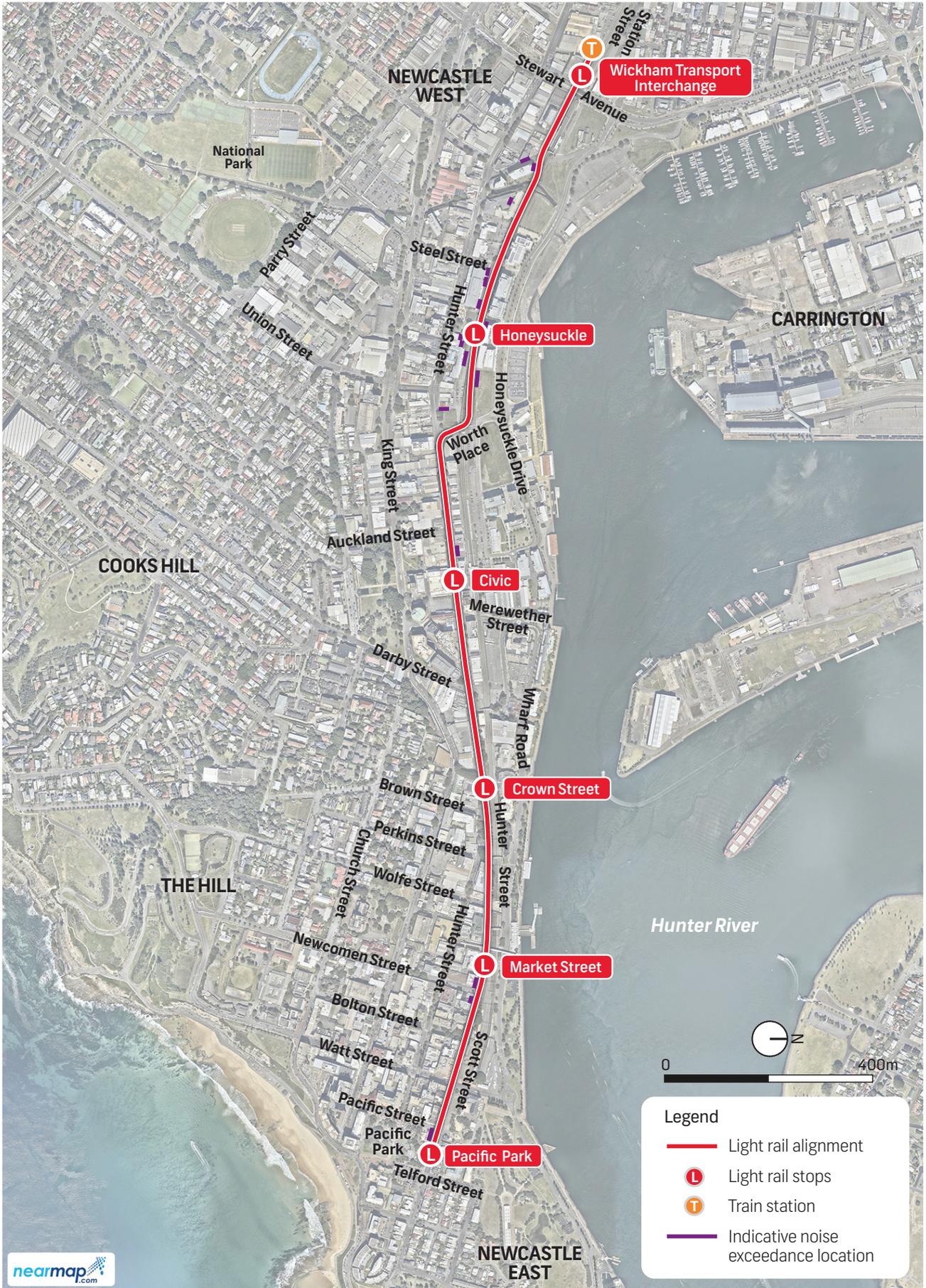


Figure 9.3 Indicative location of night-time operational noise exceedances

Night time average and maximum noise levels during operation are anticipated to exceed the relevant trigger levels at multiple locations along the proposal site in all NCAs except in NCA1. However, it is noted that the existing noise environment along Hunter Street, Scott Street and in the vicinity of Stewart Avenue is dominated by road traffic noise at a level that is generally higher than the predicted noise levels for all but the nearest receivers to the proposal site. Additionally, it is likely that the proposed operating schedule would provide for lower levels of light rail vehicle movements at more sensitive times, with no movements between 1 am to 5 am.

As the operational noise criteria are predicted to be exceeded at some receptors, an investigation of feasible and reasonable noise mitigation measures to minimise the predicted noise levels would be undertaken. This would include verification of the façade performance of non-residential receivers and iteration of the noise modelling. Effective treatment of curving noise, including wheel squeal, has the potential to reduce operational noise levels considerably in the vicinity of curves.

At receivers where the results of additional modelling indicate exceedances of the operational noise criteria, reasonable and feasible noise mitigation would be implemented. A range of preliminary noise mitigation options have been considered and are outlined in Table 9.11. It is noted that some of these measures are likely to be more feasible than others, however a review of these (and any other) reasonable and feasible measures would be undertaken during the next phase of design to determine the package of measures to be implemented. The final form of the mitigation measures would be determined during detailed design.

Table 9.11 Summary of potential operational noise mitigation options for light rail operation

Mitigation option	Description
Friction modifiers	Friction modifiers are often used to minimise curving, flanging and wheel squeal type noises as the light rail vehicles moves over these sections of track. Properly selected and applied friction modifiers have the potential to remove additional noises generated on curves. The effectiveness may be limited for extremely tight curves (<30 m radius) and this measure would not be applicable to straight sections of track.
Minimise rail/wheel roughness	Reductions in noise may be achieved where track roughness is a significant factor in overall noise levels emitted. Specifications for track maintenance may be included as an operational requirement measure.
Define more stringent noise requirements in LRV specifications	It may be possible to specify more stringent noise levels for light rail vehicles during the procurement process, following consultation with rolling stock providers to establish whether more stringent noise specifications could feasibly be achieved.
Lower noise track-forms	Lower noise track-forms, which include absorptive materials, have the potential to provide reductions in the order of two to five dB compared to a concrete slab-track. Requirements for resistance to abrasion and wear due to traffic limit the areas where this is feasible. Vegetated track forms are a low-noise option successfully implemented in Europe. Ballasted track is considered to be absorptive/low noise.
Noise barriers	There may be opportunities for the implementation of noise barriers along the ballasted sections of track (in the former rail corridor). Barriers have the potential to provide about five to 12 dB attenuation.
Building treatments including mechanical ventilation	Where other forms of mitigation are not considered to be reasonable or feasible, or residual impacts exist following mitigation, building treatments (including mechanical ventilation) may be a last resort for affected receivers. Mechanical ventilation generally allows windows to remain closed, thereby achieving approximately 10 dB additional noise reduction for noise entering

Mitigation option	Description
	<p>an internal building space assuming standard glazing. Further reductions are possible for special acoustic glazing and other façade treatments.</p> <p>No benefit is achieved for outdoor areas or buildings with existing fixed glazing, unless additional acoustic upgrades are implemented.</p> <p>Retrofitting another glass layer is often viable for heritage structures where windows cannot be changed.</p>
Reduce operating speeds during non-peak periods	<p>It may be possible to reduce operating speeds outside of peak periods, particularly at night. Reducing operating speeds by 10 km per hour may reduce noise levels by up to about five dB. It is noted however that operating speeds have been proposed to achieve the desired level of service and that changed speeds would affect the convenience of the service for customers. Reducing operating speeds is an option that would be reviewed to mitigate noise issues in sensitive areas. However, the reduced speeds may not have a significant impact, given the relatively short distances between stops and the localised nature of the noise sensitive properties.</p>

Any future developments occurring in close proximity to the light rail route that may be affected by noise emissions, must take into consideration *Development Near Rail Corridors and Busy Roads – Interim Guideline* (Department of Planning, 2008).

Noise impacts from operation of stationary infrastructure

Noise from light rail stationary infrastructure was analysed and included the following noise sources:

- the stabling and maintenance facility
- light rail vehicles moving in the stabling and maintenance facility
- substations
- light rail stops, for example noise from the public address system.

The predicted noise levels show that, without mitigation, the adopted noise criteria are likely to be exceeded at nearby noise sensitive receiver locations to the maintenance and stabling facility and substations.

Receivers in NCA1, NCA2, and NCA3 that are closest to the maintenance and stabling facility are most likely to be affected by any noise emissions, with potential exceedances of up to 20 dB, particularly where operations occur during the night-time period. LA_{max} noise level predictions also indicate possible sleep disturbance impacts in NCA2.

As with other similar maintenance and stabling facilities elsewhere, such as those located in Hamilton (Newcastle) and in Macdonaldtown (Sydney), by conducting a review of the design and operating practices, the key elements contributing to noise exceedances can be identified and adjusted where practicable to reduce the potential for exceedances. Reasonable and feasible means to achieve this would be investigated during the detailed design phase. Potential mitigation measures are presented in Table 9.12.

Table 9.12 Summary of potential stationary noise source mitigation measures

Item	Mitigation description
Workshop	Closure of the eastern doors during maintenance activities and acoustic treatment of the building would likely achieve compliance of internal operations.
Wash bay	Enhanced noise attenuation could be incorporated into the wash bay structure to reduce noise emissions. If additional mitigation is required to further reduce noise to acceptable levels, operational restrictions may be considered.
Stabling area	<p>A range of measures and practices would be reviewed to ensure that excessive noise levels are minimised:</p> <ul style="list-style-type: none"> • Noise levels from light rail vehicle rooftop plant would be considered in the tender specification. • Management measures, for example switching off rooftop plant items on entry to the stabling area, may also be effective and would be considered. • Alternative horn and bell usage practices – investigate the possibility of: <ul style="list-style-type: none"> – undertaking brake testing only during daytime hours – not using bells and horns at night or using low noise warnings such as digital flashing lights.

Without mitigation, operation of the substations and noise due to PA systems at platforms was predicted to exceed the adopted noise criteria, however this can be mitigated through appropriate design specification and procurement.

Due to the potential for exceedances of the proposal specific criteria and the potential for sleep disturbance impacts due to the operation of stationary infrastructure, noise mitigation measures are warranted.

Operational vibration

Vibration sensitive facilities

The vibration criteria for critical working areas (for example, operating theatres in potentially vibration sensitive medical facilities) may be exceeded for structures located within 25 metres of the track (for the 60 kilometres per hour section), and within 18 metres of the track (for the 40 kilometres per hour section). However, the assessment is based on a worst case scenario, which assumes that critical working areas are located at the front of buildings, closest to the proposal site. Therefore, during detailed design, a review of the location of the critical areas for each sensitive structure would be undertaken, and the potential vibration impacts would be confirmed.

Residences and commercial structures

The predicted vibration levels for light rail operations indicate that the vibration goals for residential and commercial receivers would be met.

The findings of the operational vibration assessment would be confirmed at the detailed design stage.

Road traffic noise

Most of the road traffic changes involve only minor works to improve traffic flows following implementation of the proposal and are not intended to increase traffic carrying capacity. The results of the assessment indicate that traffic noise levels are expected to decrease as a result of reduced traffic on Hunter Street and Scott Street. Traffic noise is also predicted to decrease on Merewether Street between Hunter Street and Wharf Road, and on Honeysuckle Drive from Hannell Street to Worth Place.

Minor increases in traffic noise are predicted for Stewart Avenue between Hunter Street and King Street, King Street from Stewart Avenue to Darby Street, Union Street, Darby Street, and Honeysuckle Drive between Wolfe Street and Watt Street. However, the traffic noise increases predicted for these roads are all less than two dB(A), which represents a minor increase that would be imperceptible to the average person.

Cumulative impacts

There is the potential for cumulative operational noise and vibration impacts for residential receivers on Beresford Street exposed to noise from the Wickham Transport Interchange and the proposal's stabling and maintenance facility. Cumulative impacts would be evaluated at detailed design stage when further information relating to the transport interchange design is available.

9.5 Mitigation measures

9.5.1 Detailed design/pre-construction

- The predicted noise and vibration levels, and the required noise and vibration mitigation measures, would be confirmed during the detailed design phase. Reasonable and feasible mitigation would be implemented to reduce exceedances associated with the operation of the proposal.
- Further design work and iterative noise modelling would be undertaken as the design progresses to identify reasonable and feasible mitigation measures for operational noise. This would involve consideration of the measures summarised in Table 9.11. The final form of the mitigation measures would be determined during detailed design.
- The final track design and associated operational groundborne noise and vibration mitigation measures would be addressed in the detailed design of the track. More detailed investigations would be conducted including measurement of existing internal and external noise and vibration levels, including groundborne noise and vibration levels due to the existing road traffic. These investigations would inform the required design in these locations and confirm the appropriateness of the groundborne operational noise design goals.
- Where exceedances of other non-residential sensitive receiver noise levels have been predicted, this would be verified in the detailed design stage, including further investigation of the façade performance of these receivers.
- Further design work and iterative noise modelling would be undertaken as the design progresses to identify reasonable and feasible mitigation measures that would reduce exceedances from stationary noise sources including from the stabling and maintenance facility. The design of the stabling and maintenance facility and associated mechanical equipment would include noise mitigation measures (as required) to comply with the *Industrial Noise Policy* (NSW, 2000) criteria at the nearest noise sensitive receivers. This would involve consideration of the measures summarised in Table 9.12. The final form of the mitigation measures would be determined during detailed design.
- The operational noise from the substations would be controlled by inclusion of appropriate mitigation, such as shielding or enclosures, and specification of equipment selection, to comply with the *Industrial Noise Policy* at all locations.
- The detailed design of public address systems at the light rail stops would include noise mitigation measures to minimise potential noise impacts at the nearest receptors to the stops to comply with the *Industrial Noise Policy* at all locations.

9.5.2 Construction

- Where noise and vibration criteria are predicted to be exceeded, mitigation measures documented in the *Construction Noise Strategy* (TfNSW, 2012) would be adopted where feasible and reasonable, as specified in Technical Paper 2. A noise and vibration management plan would be prepared as part of the CEMP. It would include a detailed list of the measures that would be implemented during construction, in accordance with the *Construction Noise Strategy* to minimise the potential impacts of noise and vibration on the local community, buildings and heritage structures. An outline of the requirements for the CEMP, including a list of the noise and vibration management measures to be incorporated, is provided in section 16.3.
- Where noise and/or vibration levels are predicted to exceed acceptable levels after implementation of the standard mitigation measures specified by the noise and vibration management plan, the relevant additional mitigation measures detailed in the *Construction Noise Strategy* would be considered.
- Where possible, work generating high noise and/or vibration levels would be undertaken during standard daytime working hours. Work undertaken outside of standard hours would require adequate justification and would typically require additional mitigation measures in accordance with the *Construction Noise Strategy* (TfNSW, 2012).
- If out of hours works are required, the contractor would prepare and submit a TfNSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval at least 10 business days prior to the works being undertaken. All out of hour works and activities would be undertaken with additional mitigation measures in accordance with the *Construction Noise Strategy* (TfNSW, 2012).

9.5.3 Operation

The following would be included in the Operator's environmental management procedures:

- Transformers, rectifiers and other electrical equipment on site would be well maintained and operated according to specifications.
- Operational noise monitoring would be undertaken within six months of commencement and at regular periods to assess compliance against operational noise criteria listed in Table 9.4.
- If the results of monitoring indicate that operational noise levels are significantly higher than those modelled for the REF, investigation of additional acoustic treatment would be undertaken.
- Maintenance operations would be scheduled during the day, where possible.
- Any noise complaints would be managed in accordance with TfNSW's complaints management procedure.

10. Non-Aboriginal heritage

A heritage impact assessment of the proposal was undertaken for the proposal. A technical report is available as 'Technical Paper 3 – Statement of Heritage Impact' on the TfNSW website (www.transport.nsw.gov.au). A summary of the assessment is provided in the following sections.

10.1 Assessment approach and methodology

The assessment involved:

- identifying listed heritage items in the vicinity of the proposal site by searching relevant heritage databases.
- a site survey and photographic inventory.
- reviewing the proposal description and plans.
- reviewing the *Newcastle Archaeological Management Plan* (Suters Architects, 1997), the *Newcastle Archaeological Management Strategy* (City of Newcastle, 2015) and *Newcastle Archaeological Management Plan Review* (Higginbotham, 2015).
- preparing a statement of heritage impact in accordance with the following guidelines:
 - *Assessing Heritage Significance* (Heritage Office, 2001)
 - *Statements of Heritage Impact* (Heritage Office, 2002)
 - *The Burra Charter* (Australia ICOMOS, 2013).

This section considers the potential impacts of the proposal on items within the proposal site, and those items that are located within 50 metres of, and with clear line of sight to, the proposal site.

10.2 Existing environment

10.2.1 Heritage context

Newcastle is one of the oldest European settlements in Australia. The proposal site is located within a historically significant area of Newcastle as a result of its inner city location. The inner city area of Newcastle is based on the original settlement, which was established on the sand hills of the Hunter River delta. Coal was the stimulus for the first settlement in this area of Newcastle, leading to the establishment of a garrison outpost in 1801 on the southern side of the Hunter River (known as the Coal River until 1804). In 1804, a penal settlement was established at Newcastle, and operated until 1822. Newcastle served as one of the main penal settlements in NSW (AMBS, 2005).

Coal mining on a large scale commenced in 1828 when the Australian Agricultural Company was given a 2,000 acre parcel of coal bearing land in inner Newcastle. The opening of the railway in the 1850s further stimulated industrial activity (City of Newcastle, 2014).

The decline of coal mining in inner Newcastle around 1900 had a strong influence on growth, freeing large areas of land previously used for mining and railway purposes for future development. Newcastle's population increased rapidly following the opening of the Broken Hill Proprietary (BHP) steelworks in 1915 (Suters, 1997).

The Second World War stimulated Newcastle's manufacturing base during the war and the post war period. From the 1960/70s, the central business district was affected by the decline in the

population of the inner city, and the rise of regional shopping centres, which led to closures of numerous shops and businesses.

The closure of the steelworks in 1999 has led to significant economic and social changes in Newcastle, as the city has transitioned from having a strongly industrial economic base to a more diversified modern economy, dominated by the healthcare, services and education sectors. At the same time, revitalisation of vacant industrial land near the waterfront at Honeysuckle and new residential developments in the inner city are further transforming the city (City of Newcastle, 2014).

10.2.2 Heritage listed items

The built heritage in the study area reflects the evolution and expansion of Newcastle from the arrival of the first European settlers to the present day. The city centre includes a number of built and non-Indigenous heritage features of State and/or local significance.

The heritage listed items within or adjacent to the proposal site, and those within 50 metres of the site, are described below and listed in Table 10.1. The locations of these items are shown in Figure 10.1.

State heritage items

There are no items listed on the State heritage register located within the proposal site.

The following eight items listed on the State heritage register are located within 50 metres of the proposal site:

- Frederick Ash Building
- Victoria Theatre (former)
- Newcastle Railway Station
- Newcastle Railway Station additional group
- Newcastle Customs House
- Enterprise Park and Coult's Sailors Home (former)
- Convict Lumber Yard or Stockade Site
- Great Northern Hotel.

Local heritage items

Two items, listed by the LEP, are located within the proposal site:

- Wickham Railway Station
- Wickham Signal Box.

There are 28 other locally listed items located within 50 metres of the proposal site (refer Figure 10.1 and Table 10.1).

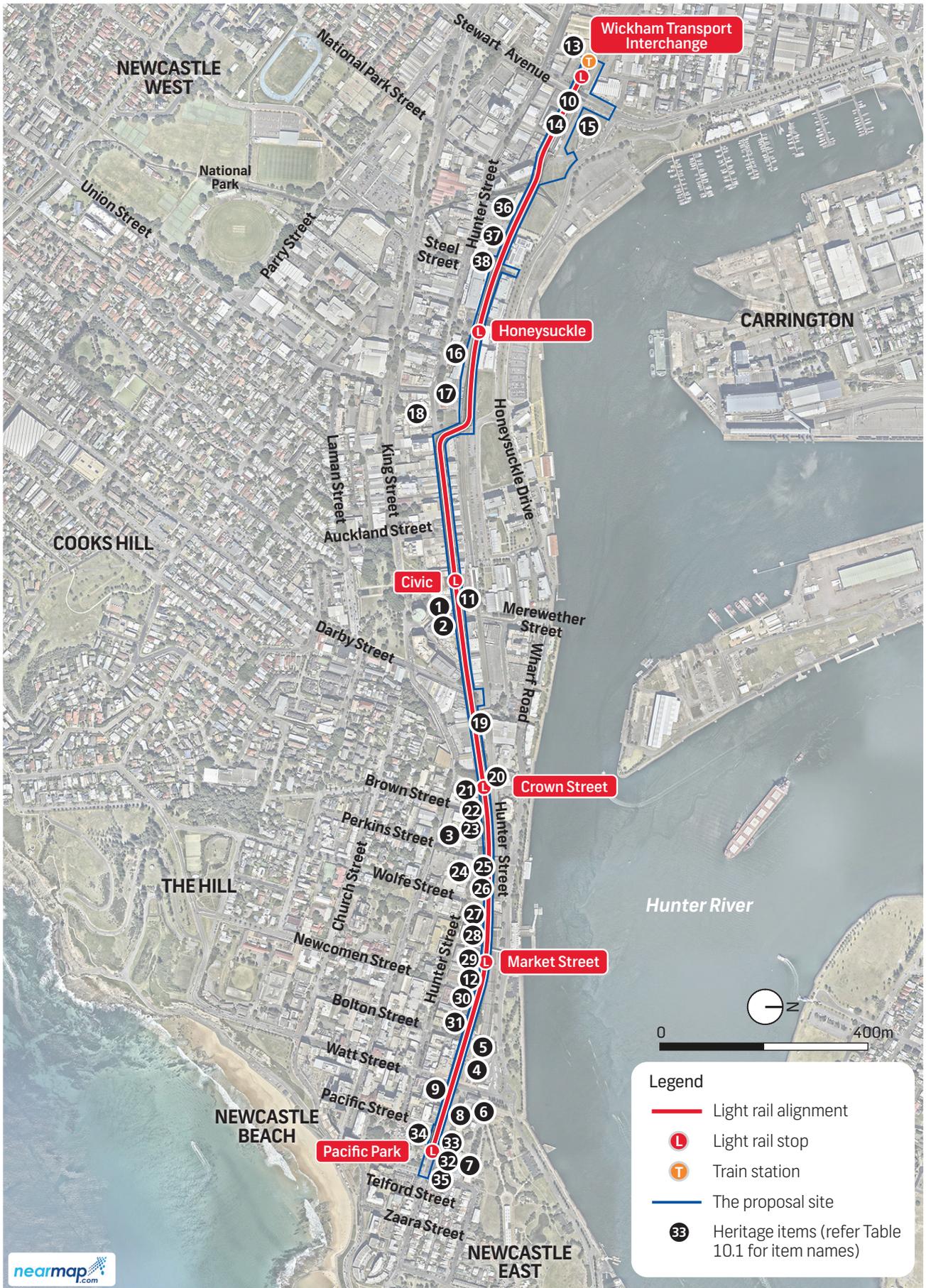


Figure 10.1 Heritage items in and near the proposal site

Items listed in accordance with section 170 of the Heritage Act

Two items, listed on RailCorp's section 170 register (the Wickham and Newcastle Railway Station groups), are located within the proposal site. Two items are located close to the proposal site:

- Civic Railway Station Group – listed on RailCorp section 170 register
- Newcastle Port Corporation – listed on Newcastle Port Corporation section 170 register.

10.2.3 Heritage conservation areas

The proposal site is located within the Newcastle City Centre Heritage Conservation Area (listed by the LEP).

10.2.4 Archaeological sites

The Cottage Creek Cemetery site is located near Cottage Creek and contains the remains of the Honeysuckle Point Cemetery and Newcastle West Cemetery. Prior to use as a cemetery, in the early period of Newcastle's settlement, it was the western part of the area known as Government Farm. This archaeological site is not registered.

The Palais Royale site (Government Farm Archaeological Site) overlaps the proposal site. This site is listed under the LEP and is the only listed archaeological site impacted by the proposal.

Recent investigations in the former rail corridor for the Wickham Transport Interchange project have revealed surface archaeological evidence of unidentified elements of the long demolished Honeysuckle Railway Station complex (1872 – 1938) near Steel Street (south of railway line) (RPS 2014). This archaeological site is not registered.

The central northern portion of the Convict Hut Archaeological Area (Higginbotham, 2013) is located within the proposal site. Although this area is not formally listed as a heritage item, it is associated with the State heritage listed Convict Lumber Yard or Stockade Site.

Table 10.1 Heritage listed items and places within and in the vicinity of the proposal site

Item name	Map ref (Figure 10.1)	Address	Location with respect to the proposal site/distance from site
State heritage items			
Frederick Ash Building	2	359-361 Hunter Street	Adjacent to the proposal site
Victoria Theatre (former)	3	8-10 Perkins Street	Building is located about 60 metres from the proposal site and the curtilage extends to about 10 metres from the proposal site
Newcastle Railway Station	4	Great Northern Railway	Adjacent to the proposal site
Newcastle Railway Station additional group	5	Great Northern Railway	Adjacent to the proposal site
Newcastle Customs House	6	1 Bond Street	About 30 metres north of proposal site
Enterprise Park and Coult's Sailors Home (former)	7	Bond Street	Adjacent to the proposal site
Convict Lumber Yard or Stockade Site	8	98 Scott Street	Adjacent to the proposal site

Item name	Map ref (Figure 10.1)	Address	Location with respect to the proposal site/distance from site
Great Northern Hotel	9	89 Scott Street	Adjacent to the proposal site
Section 170 register items			
Wickham Railway Station Group	10	Hannell Street	In proposal site
Civic Railway Station Group	11	Hunter Street	About 30 metres north of proposal site
Newcastle Railway Station Group	4	110 Scott Street	The eastern compound is within the heritage curtilage
Newcastle Port Corporation Building	12	Corner Newcomen and Scott streets	Adjacent to the proposal site
Local heritage items			
Former Newcastle Co-operative Store	13	854 Hunter Street	Adjacent to the proposal site
Wickham Railway Station	10	Hannell Street	In proposal site
Wickham Signal Box	14	Hannell Street	Adjacent to the proposal site
Former School of Arts	15	80 Honeysuckle Drive	About 30 metres north of proposal site adjacent to the western site compound
Newcastle Technical College	16	590-608 Hunter Street	Adjacent to the proposal site
Former Police Station	17	558 Hunter Street	Adjacent to the proposal site
Former Emporium Building	18	517-525 Hunter Street	About 40 metres south west of proposal site
Civic Theatre (part of the State Heritage Register listed item 'Newcastle City Hall and Theatre Precinct')	1	373 Hunter Street	Adjacent to the proposal site
Former Frederick Ash Building	2	359-361 Hunter Street	Adjacent to the proposal site
Tramway Substation (former)	19	342 Hunter Street	Adjacent to the proposal site
Remains of AA Co. Bridge and Fence	20	280 Hunter Street	Adjacent to the proposal site
Lucky Country Hotel	21	237 Hunter Street	Adjacent to the proposal site
Former ANZ Bank	22	102 Hunter Street	Adjacent to the proposal site
Crown and Anchor	23	189 Hunter Street	About 16 metres south of proposal site
David Jones	24	169-185 Hunter Street	About 20 metres south of proposal site
Commonwealth Bank Building (former)	25	220 Hunter Street	Adjacent to the proposal site
Johns Building (former)	26	200-212 Hunter Street	Adjacent to the proposal site
Former School of Arts	27	182 Hunter Street	Adjacent to the proposal site
Beberfaulds Warehouse	28	175 Scott Street	Adjacent to the proposal site
Rundles Buildings (former R Hall & Sons)	29	161 Scott Street	Adjacent to the proposal site
Air Force Club (Wood Chambers)	30	129 Scott Street	Adjacent to the proposal site

Item name	Map ref (Figure 10.1)	Address	Location with respect to the proposal site/distance from site
Centennial Hotel	31	127 Scott Street	Adjacent to the proposal site
Newcastle Railway Station	4	110 Scott Street	Adjacent to the proposal site
Newcastle Customs House	6	1 Bond Street	About 30 metres north of proposal site
Great Northern Hotel	9	89 Scott Street	Adjacent to the proposal site
Former Convict Lumber Yard – Stockade site (Coal River Precinct)	8	92 Scott Street	Adjacent to the proposal site
Former Residence	32	90 Scott Street	Adjacent to the proposal site
Former Station Master’s Residence	33	92 Scott Street	Adjacent to the proposal site
Former Newcastle East Police Station	34	63 Scott Street	Adjacent to the proposal site
Former Superintendent’s Residence	35	88 Scott Street	Adjacent to the proposal site
Heritage conservation areas			
Newcastle City Centre Heritage Conservation Area	-		The whole of the proposal site is located within the area
Archaeological sites (listed and non-listed sites)			
Cottage Creek Cemetery site (not formerly listed)	36	Cottage Creek	Northern portion of area extends into the proposal site
Palais Royale (Government Farm Archaeological Site)	37	684 Hunter Street	Northern portion of area extends into the proposal site
Honeysuckle Railway Station complex (not formerly listed)	38	684 Hunter Street	Footings recently uncovered in the former rail corridor within the proposal site during other works
Convict Hut Archaeological Area (not formerly listed)	39	98 Scott Street	Associated with the State heritage listed Convict Lumber Yard or Stockade Site located adjacent to proposal site

10.2.5 Archaeological potential

The proposal site has been divided into five areas for the purpose of describing the archaeological context and potential. These areas, which are listed in Table 10.2 and are shown in Figure 10.2, reflect the successive periods of occupation in inner Newcastle. The potential for each area to have historic relics and archaeological material was assessed. The results of the assessment are summarised in Table 10.2.

Table 10.2 Areas of archaeological potential

Area (mapped on Figure 10.2)	Key features/listed heritage items	Summary of archaeological potential and significance
1 Wickham Transport Interchange to Cottage Creek	<p>Encompasses the western portion of the proposal site between the Wickham Transport Interchange and Cottage Creek.</p> <p>Includes listed items associated with Wickham Station.</p> <p>May contain evidence of post 1850s occupation.</p> <p>Has not been archaeologically tested.</p>	<p>Moderate potential for the discovery of rail works of local significance.</p>
2 Former Cottage Creek Cemetery	<p>Occupied during the convict era.</p> <p>Associated with the former Cottage Creek Cemetery. Prior to use as a cemetery it was part of the area known as Government Farm.</p> <p>Remains identified during archaeological excavations in 2001.</p>	<p>Moderate potential for historic relics of local significance.</p>
3 Palais Royale (Government Farm archaeological site)	<p>Occupied during the convict era.</p> <p>Associated with the Palais Royale (Government Farm archaeological site) listed by the LEP. The Palais Royale site has been identified as a sensitive historical archaeological area.</p> <p>Recent works have located the footings of the former Honeysuckle Station on the north eastern boundary of area 3.</p>	<p>Moderate potential for historic relics of local significance.</p>
4 Steel Street, Newcastle to Worth Place, Newcastle	<p>Includes the former rail corridor between Steel Street and Worth Place, and the area of Hunter Street between Worth Place and Brown Street.</p> <p>Has not been archaeologically tested.</p>	<p>Moderate potential for historic relics of local significance</p>
5 Convict Huts and Convict Lumber Yard Archaeological Area	<p>Encompasses the eastern end of the proposal site from Brown Street to Telford Street.</p> <p>Includes the Convict Hut Archaeological Area (not formerly listed).</p> <p>Occupied during the convict era and may contain relics and archaeological deposit relating to the convict era.</p> <p>May contain evidence of post 1850s occupation.</p>	<p>Moderate to high potential to contain archaeological material and may contain historic relics of state significance.</p>

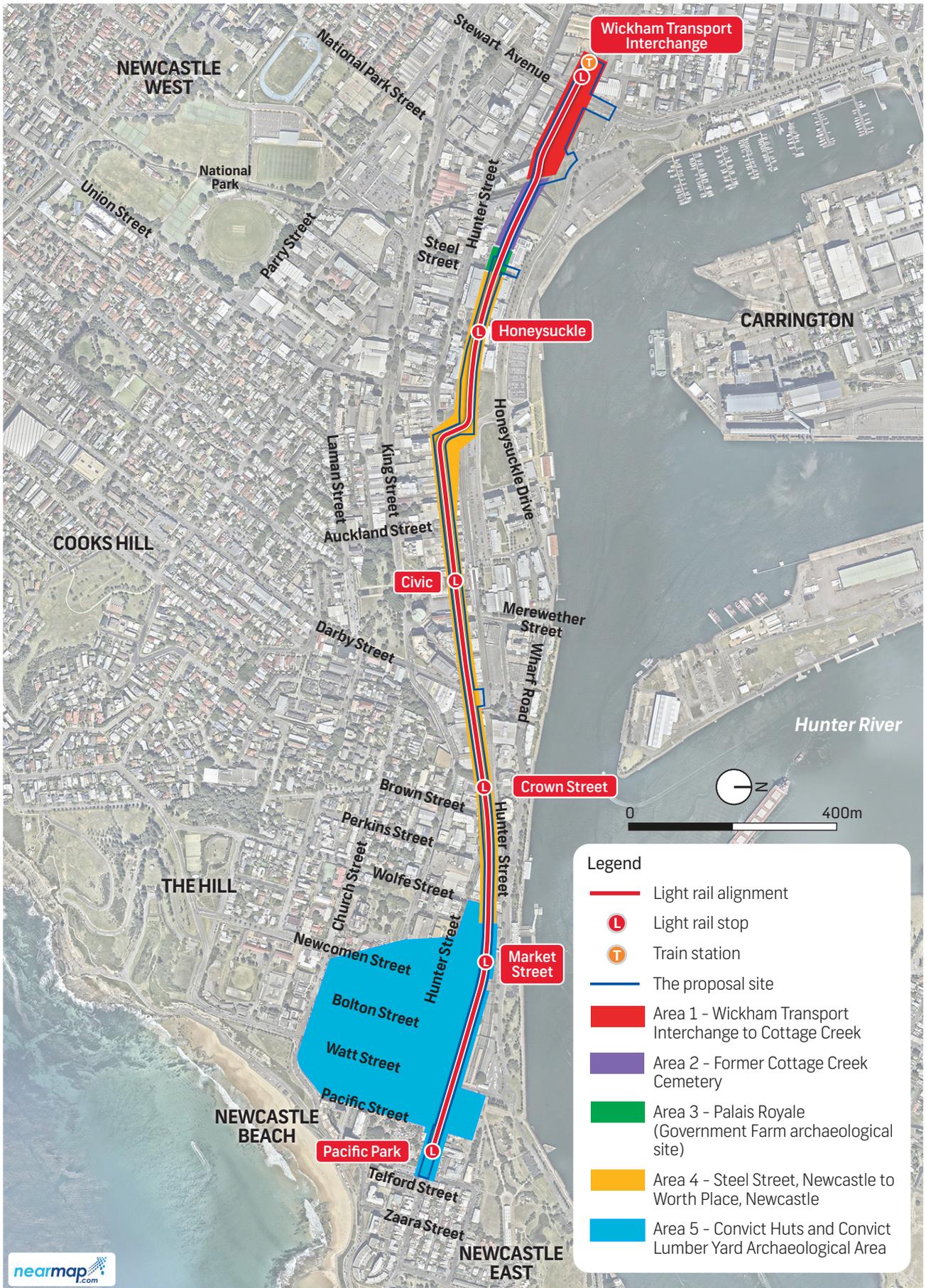


Figure 10.2 Archaeological potential areas

10.3 Impact assessment

Construction and operation of the proposal would have the potential to impact on heritage items and archaeological sites/areas. There may be direct impacts to heritage items (for example, as a result of removal of or change to an item) or indirect impacts (such as vibration impacts and/or as a result of changes to the setting, context and appreciation of items). Potential impacts are described below.

10.3.1 Potential for direct impacts on listed items

Direct impacts as a result of the proposal include:

- the removal of Wickham Station and associated buildings/items
- works in the Newcastle City Centre Heritage Conservation Area
- the eastern construction compound is located within the curtilage of the Newcastle Railway Station section 170 register listing
- impacts to archaeological sites – Cottage Creek Cemetery site, Palais Royale (Government Farm Archaeological Site), Honeysuckle Railway Station and the Convict Hut Archaeological Area – as a result of excavation/ground disturbance in these areas
- impacts to historic relics associated with excavation/ground disturbance in the areas of archaeological potential.

The potential for direct impacts on listed items is considered below.

Wickham Station removal

The proposal involves the removal of the locally listed Wickham Station buildings and facilities. The heritage assessment concluded that the removal of Wickham Station and associated buildings would have an adverse impact on its heritage value. However, the heritage assessment notes that the item does not play a major and recognisable role in the streetscape of the Newcastle City Centre Heritage Conservation Area, and that the removal of this item will have a minor overall impact on the heritage significance of the conservation area.

To mitigate the impacts of its removal, a full archival recording of the item would be undertaken and a heritage interpretation plan produced. The measures listed in section 10.4 would be implemented prior to construction commencing.

Newcastle City Centre Heritage Conservation Area

The Newcastle City Centre Heritage Conservation Area, covering the city centre, provides a mix of commercial, retail and civic buildings that reflect the city's economic and social history.

Overall, the proposal would not permanently impact the significance of the conservation area as a whole. Construction of the proposal would have a temporary impact on the conservation area as a result of the presence of construction equipment and areas of disturbance. Detailed design of the proposal would seek to minimise the potential impacts on the heritage significance of the conservation area. Operation of the proposal would involve providing an additional form of transport in the conservation area. Provided that measures are taken to minimise the potential for indirect impacts to historic buildings and heritage listed items within the conservation area, no impacts to the area are predicted.

Newcastle Station

The eastern construction compound is within the curtilage of the section 170 register listing of the Newcastle Railway Station Group. However, there are no built heritage items in the area

proposed for the compound and the compound is not within the curtilage of the State Heritage Register or LEP listing. There is potential for inadvertent physical impact during construction works. This would be mitigated by installing temporary fencing. Sydney Trains would be notified.

Impacts to archaeological sites/relics

Wickham Transport Interchange (Area 1) and Steel Street to Worth Place (Area 4)

These sites/areas contain relics considered to be significant at the local level. Excavation works may uncover and/or impact on relics. A Heritage Act section 139(4) excavation exception (type 1C) application would be sought prior to commencing any works in this area. The measures listed in section 10.4 would be implemented to minimise the potential for impacts.

Cottage Creek Cemetery site (Area 2) and the Palais Royale (Government Farm Archaeological Site) (Area 3)

These sites/areas contain relics considered to be significant at the local level. Excavation works may uncover and/or impact on relics. A Heritage Act section 139(4) excavation exception (1B) application would be sought prior to commencing any works in this area. The measures listed in section 10.4 would be implemented to minimise the potential for impacts.

Honeysuckle Railway Station (Area 3)

This site contains relics considered to be significant at the local level. Excavation works may uncover and/or impact on relics associated with this site. Approval would be sought under section 140 of the *Heritage Act 1977* prior to commencing any works in this area. The measures listed in section 10.4 would be implemented to minimise the potential for impacts on the site.

Convict Huts Archaeological Area and Convict Lumber Yard (Area 5)

Area 5 includes the Convict Hut Archaeological Area identified in the *Newcastle Archaeological Management Plan Review* (Higginbotham, 2013). Although this area is not formerly listed as an archaeological site, the curtilage of the Convict Lumber Yard, which is listed on the State heritage register, abuts the proposal site.

Area 5 may contain evidence for convict huts, but this has not been demonstrated archaeologically and this area is not formally listed on a heritage register. If convict huts were identified, then they would be of state significance. There is no archaeological evidence, as yet, which suggests the Convict Lumber Yard extends beyond the identified curtilage. As a result, a state significant archaeological deposit has not been demonstrated. Given the limited nature of subsurface works associated with the proposal the following would be implemented:

- A section 139(4) excavation exception (1B) application should be drafted by a qualified historical archaeologist and submitted for approval by the Heritage Council.
- An archaeological monitoring program would be implemented to determine if the State significant archaeological resource extends into the proposal site. The results would determine if any approval is required under section 57(1) of the Heritage Act.

The measures listed in section 10.4 would be implemented to minimise the potential for impacts on Area 5 and the State heritage listed Convict Lumber Yard or Stockade Site.

10.3.1 Potential for indirect impacts

Potential indirect impacts as a result of the proposal include:

- potential for groundborne noise and vibration impacts to buildings located close the proposal site as a result of construction works and the movement of plant, vehicles and machinery
- any inadvertent damage to items located close to the proposal site.

- presence of new infrastructure associated with the operation of the proposal which may change the setting and/or character of areas.

The main potential for impact relates to vibration generated by construction works. The potential for vibration impacts is considered further in chapter 9 and Technical Paper 2. Potential impacts would be minimised by adopting the recommended minimum buffer distances for specified plant items, and where necessary, monitoring levels at potentially affected structures.

For items immediately adjacent to the proposal site, the proposal would have no adverse impacts on the identified heritage significance of these items, provided that measures are taken to prevent accidental physical impact.

The implementation of the mitigation measures provided in section 10.4 would minimise the potential for indirect impacts on heritage items.

10.4 Mitigation measures

10.4.1 Detailed design and pre-construction

General

- Detailed design of the proposal would be sympathetic to the surrounding heritage items/elements and the significance of the Newcastle City Centre Heritage Conservation Area.
- A heritage induction would be developed for employees and contractors. The induction would outline the responsibilities and requirements of the heritage management plan. All workers, contractors and visitors would be required to complete the heritage induction.
- Pre-construction requirements in relation to the archaeological areas are provided in Table 10.3.

Approvals and consultation

- Consultation would be undertaken with Council in accordance with the requirements of clause 14 of the Infrastructure SEPP in relation to the removal of Wickham Station.
- The Heritage Division would be informed in writing at least 14 days before removal of the buildings associated with Wickham Station.
- The Statement of Heritage Impact would be provided to Sydney Trains in relation to potential impacts on the items listed on their section 170 register.
- An exception application would be made and approval received under section 139(4) of the *Heritage Act 1977* prior to construction in archaeological areas 1 and 4 (exception type S139(1C)) and 2, 3 and 5 (exception type S139(1B)).
- Approval would be sought under section 140 of the *Heritage Act 1977* to impact on the footings of the former Honeysuckle Station in archaeological area 3. Approval would be received prior to any excavation work commencing in this area.

Wickham Station

- Full archival recording of Wickham Station and the associated buildings would be undertaken prior to removal of any structures.
- A heritage interpretation plan would be developed, consistent with *Interpreting Heritage Places and Items Guidelines* (NSW Heritage Office, 2005) to provide the strategies for communicating information on the history of the station.

- Materials salvaged from the structures would be reused where appropriate in accordance with the heritage interpretation plan.

10.4.2 Construction

Heritage items

- A heritage management plan would be prepared as part of the CEMP. An outline of the requirements for the CEMP, including a list of the heritage management measures to be incorporated, is provided in section 16.3.

Archaeological areas

- Requirements in relation to construction in each of the archaeological areas are provided in Table 10.3.

Table 10.3 Management and mitigation measures for archaeological areas

Area		Works in area
1	Wickham Transport Interchange to Cottage Creek	<ul style="list-style-type: none"> • The area required for excavation would be minimised in this area. • If relics are uncovered, they would be managed in accordance with the unexpected finds measure included in the CEMP (provided in section 16.3).
2	Former Cottage Creek Cemetery	<ul style="list-style-type: none"> • The area required for excavation would be minimised in this area. • Archaeological monitoring would be undertaken during works. • If relics are uncovered, they would be managed in accordance with the unexpected finds measure included in the CEMP.
3	Palais Royale (Government Farm archaeological site) and former Honeysuckle Station	<ul style="list-style-type: none"> • The area required for excavation would be minimised in this area. • Archaeological monitoring would be undertaken during works. • If relics are uncovered, they would be managed in accordance with the unexpected finds measure included in the CEMP.
4	Steel Street, Newcastle to Worth Place, Newcastle	<ul style="list-style-type: none"> • The area required for excavation would be minimised in this area. • If relics are uncovered, they would be managed in accordance with the unexpected finds measure included in the CEMP.
5	Convict Huts and Convict Lumber Yard Archaeological Area	<ul style="list-style-type: none"> • The area required for excavation would be minimised in this area. • An archaeological monitoring program would be implemented to determine if the State significant archaeological resource extends into the proposal site. The results would determine if approval under section 57 of the Heritage Act is required. • If relics are uncovered, they would be managed in accordance with the unexpected finds measure included in the CEMP.

11. Aboriginal heritage

A heritage impact assessment of the proposal was undertaken for the proposal. A technical report is available as 'Technical Paper 4 – Aboriginal heritage due diligence assessment' on the TfNSW website (www.transport.nsw.gov.au). A summary of the assessment is provided in the following sections.

11.1 Assessment approach and methodology

The assessment was undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010). The assessment involved:

- searching the Office of Environment and Heritage's Aboriginal Heritage Information Management System database (AHIMS)
- reviewing the results of previous sub-surface archaeological investigations undertaken in the study area and previous reports on Aboriginal heritage in Newcastle, including the *Aboriginal Heritage Study: Newcastle Local Government Area* (AMBS, 2005)
- reviewing information on the heritage and environmental context of the proposal site
- a visual inspection of the proposal site and surrounds during a site visit
- assessing the Aboriginal archaeological potential of the proposal site
- identifying whether Aboriginal objects are present, or likely to be present, in or near the proposal site
- determining whether the proposal is likely to harm Aboriginal objects (if present) and whether an Aboriginal heritage impact permit (AHIP) is required under section 90 of the *National Parks and Wildlife Act 1974*
- providing mitigation measures, as required.

11.2 Existing environment

11.2.1 Historical context

The Awabakal and Worimi peoples are acknowledged by Council as the traditional custodians of the land and waters of Newcastle. Archaeological evidence suggests that Aboriginal occupation of the Hunter Valley region began at least 35,000 years ago (Koettig, 1987). Ethnographic references support the widespread use of the Newcastle region by Aboriginal groups, and also indicate the types of cultural material to be expected in archaeological sites throughout the area. Archaeological sites are known to occur in all landscape contexts within the Newcastle region, and include site types such as open camp sites, middens, axe-grinding grooves, engravings, quarries and bora grounds.

Despite landscape modification resulting from urban development, archaeological materials have still been found throughout the developed areas, including in the city centre. For example, during archaeological excavations of the former Palais Royale (now KFC) site on Hunter Street, over 5,534 Aboriginal artefacts were recovered, representing three Aboriginal occupation periods dating from 6,716 to 6,502 years before present (AHMS, 2011). Investigations of the Ibis Hotel site at 700 Hunter Street revealed an Aboriginal shell midden (AHMS, 2001).

More recently in 2015, salvage investigations for the Wickham Transport Interchange found over 4,000 artefacts possibly representing two occupation layers, and as a result the site was rated as having a high significance and research value. These recent local investigations demonstrate the potential for evidence of Aboriginal occupation to remain as in situ deposits beneath an upper layer where historical disturbance has otherwise occurred.

11.2.2 Listed sites

The AHIMS database was searched on 15 September 2015 to identify registered (known) Aboriginal sites or declared Aboriginal places located in the study area. The results of the search indicated that 18 Aboriginal sites have been previously recorded within the search area. However two of the sites are duplicates of the same site.

Of the sites identified as a result of the search, four sites are located within the proposal site. A summary of these sites is provided in Table 11.1. The approximate location of these sites is shown in Figure 11.1.

No previously unrecorded sites were identified during the site visit.

Table 11.1 Summary of listed Aboriginal sites in the proposal site

AHIMS site reference/name	Site type	Comment
38-4-0831 (Palais Royale)	PAD	Extensive deposits within 50 metres of the proposal site, which is likely to extend into the proposal site. Considered to have moderate archaeological sensitivity
38-4-1222 (Cottage Creek OS1)	Artefact scatter	Open site with an extent of 30 by 35 metres, with possible sub-surface deposits.
38-4-1223 (Wickham UFCCALE OS1)	Artefact scatter	Open site with an extent of 5 by 10 metres, with possible sub-surface deposits. Rated as having high archaeological sensitivity
38-4-1716 (Wickham Transport Interchange)	PAD	Open site with over 4,000 artefacts salvaged. Currently under investigation. Rated as having high archaeological significance and research value

11.2.3 Summary of archaeological potential of the proposal site

Archaeological potential is defined as a site's potential to contain archaeological relics. This potential is identified through historical research and by judging whether current building or earlier building or development activities have removed all evidence of known previous land uses. As existing development has modified and obscured the natural landforms and covered all natural ground surfaces in the study area, it can be difficult to define specific areas of Aboriginal archaeological potential.

The data from previous archaeological investigations undertaken in the Newcastle city centre and in proximity to the proposal site, indicates that some Aboriginal archaeological deposits survive, even in extensively modified and developed areas. Some of these archaeological deposits have been subjected to varying levels of disturbance, but may still survive in natural soil and/or at depth.

The current landscape of the proposal site has been highly modified since settlement in the early nineteenth century. Early maps and photographs show the course of the Hunter River and Throsby Creek has changed largely through extensive reclamation. The proposal site passes through areas that are likely to have evidence of Aboriginal campsite occupation. Aboriginal

campsites are often found adjacent to creek lines, such as those located in and near the proposal site, and flora and fauna resources are likely to have been used in the vicinity.

An analysis of landform patterning and recent archaeological evidence has shown that Aboriginal occupation was likely to be more highly concentrated around Cottage Creek, and there is also high potential for similar archaeological sensitivity in the area of Brown/Crown Street, where a watercourse once existed. In recognition of the potential archaeological sensitivity of those two areas they have been designated as Landforms with Aboriginal Archaeological Sensitivity and are shown in Figure 11.1.

While these two areas provide readily identifiable indicators for archaeological sensitivity, there remains the possibility for other sites to also exist within the proposal site. This is supported by the recent findings of investigations for the Wickham Transport Interchange project and also the *Aboriginal Heritage Study: Newcastle Local Government Area* (AMBS, 2005) that found that the Hunter River estuary's southern shore had, in general, moderate archaeological potential as a result of the extensive landscape modification that has occurred since settlement.

11.3 Impact assessment

11.3.1 Construction

Impacts on listed sites

Construction would impact on the following four listed sites located within the proposal site:

- 38-4-0831 (Palais Royale)
- 38-4-1222 (Cottage Creek OS1)
- 38-4-1223 (Wickham UFCCALE OS1)
- 38-4-1716 (Wickham Transport Interchange).

An AHIP for these sites would be sought under section 90A of the *National Parks and Wildlife Act 1974* prior to ground disturbance works taking place.

Impacts on Aboriginal archaeology in general

The proposal would require excavation along the entire light rail alignment. The due diligence assessment indicates that there is the potential for Aboriginal objects to occur beneath the surface layer even in areas of historical disturbance. Excavation may impact on Aboriginal objects located in sub-surface archaeological deposits. As a result, an AHIP would be sought for the proposal site prior to ground disturbance works taking place.

11.3.2 Operation

Operation of the proposal would not impact on Aboriginal heritage.

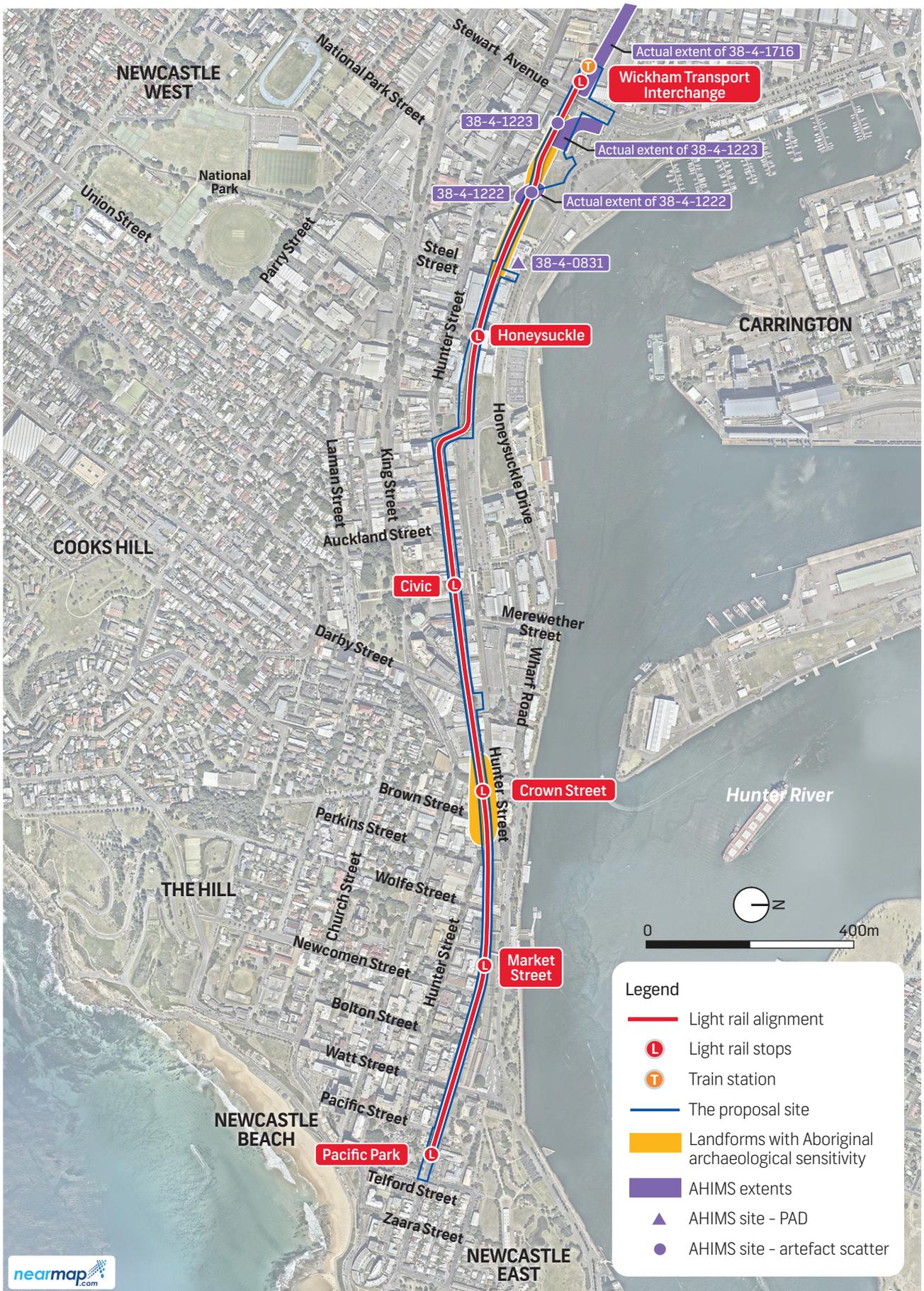


Figure 11.1 Approximate location of Aboriginal sites and areas of sensitivity

11.4 Mitigation measures

11.4.1 Detailed design and pre-construction

- An application for an AHIP would be made under section 90A of the *National Parks and Wildlife Act 1974*. The AHIP would be sought for the land and associated objects within the boundaries of the proposal site and specified Aboriginal sites and objects contained within the listed sites. The AHIP would be prepared and submitted in consultation with relevant Aboriginal stakeholders, as required under the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010). This consultation has commenced.
- The AHIP would include mitigation by performing archaeological salvage for nominated sites. Archaeological salvage would be completed prior to any activities which may harm Aboriginal objects at these locations. The archaeological salvage activities would be undertaken in accordance with the methodology developed in consultation with Aboriginal stakeholders.

11.4.2 Construction

- Measures for the management of Aboriginal heritage would be included in the heritage management plan prepared as part of the CEMP. An outline of the requirements for the CEMP, including a list of the heritage management measures to be incorporated, is provided in section 16.3.

12. Landscape character and visual impacts

An urban landscape and visual impact assessment of the proposal was undertaken by GHD. A comprehensive technical report is available as 'Technical Paper 5 – Urban Landscape and Visual Impact Assessment' on the TfNSW website (www.transport.nsw.gov.au). A summary of the results of the assessment is provided in the following sections.

12.1 Assessment approach and methodology

The urban landscape and visual assessment was undertaken with reference to the following guidelines:

- *Environmental Impact Assessment Practice Note – Guidelines for Landscape Character and Visual Impact Assessment, EIA-N04*, produced by NSW Roads and Maritime Services (2013).
- *Guidelines for Landscape and Visual Impact Assessment, Third Edition*, published by the Landscape Institute and Institute of Environmental Management and Assessment (UK) (2013).
- *Transport Analysis Guidance Unit A3: Townscape Worksheets* produced by the Department for Transport (UK).

The assessment involved:

- desktop analysis
- site visit and analysis
- establishing the baseline environment (landscape and visual) for the assessment
- identification of landscape character areas, representative viewing areas and sensitive receivers
- describing the key visual features of the construction and operation of the proposal
- assessing the potential landscape character and visual impacts of the proposal for construction and operation based on sensitivity and the magnitude of impacts
- determining the potential significance of impacts through a combined assessment of sensitivity and magnitude
- identification of mitigation and management measures as necessary.

The potential sensitivity of the landscape and visual receivers to change was determined and rated on a scale from negligible to high. Sensitivity is dependent on a number of factors, including the location of receivers, the importance of their view, activity at this location, and the extent of existing and future screening.

Landscape character impacts refer to the relative capacity of the landscape to accommodate changes to the physical landscape through the introduction of new features or the loss/modification of existing features. Impacts were assessed from representative viewpoints and rated on a scale from negligible to large.

The significance of potential landscape character and visual impacts was determined by assessing the magnitude of impact in combination with the sensitivity of the landscape/visual receiver. Potential impacts were rated according to their significance (severity), as shown in Figure 12.1. Significant impacts are considered to be those with a rating of high-moderate or above.

Further information on how the impact, sensitivity and level of significance were assigned is provided in Technical Paper 5.

A series of viewing locations were selected for the production of artist's impressions. These were prepared to visually represent the views available from selected locations during operation of the proposal.

		Magnitude of impacts			
		Large	Moderate	Small	Negligible
Sensitivity of feature	High	High	High-moderate	Moderate	Negligible
	Medium	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 12.1 Impact significance rating matrix

12.2 Existing environment

12.2.1 General visual character

The landscape and visual environment of the study area is characterised by its highly developed urban nature. Features contributing to the visual appearance of the study area include existing road and rail infrastructure, commercial developments, medium to high density residential developments and the cultural and civic centre of Newcastle around Wheeler Place.

The study area is characterised by its urban and transport infrastructure, the long and wide Hunter Street, and a mix of older commercial and residential buildings among new developments. There are several existing buildings of cultural and heritage significance within the study area. In addition, existing and proposed development projects, including the new university buildings on Hunter and King streets, the new Newcastle Courthouse on Hunter Street, the multi-storey mixed use commercial and residential development in Honeysuckle, and the redevelopment of the Hunter Street Mall, will continue to influence the character of the study area.

There is limited vegetation in the study area. The vegetation includes formal open grassed areas with ornamental trees (Pacific Park), distinctive *Ficus microcarpa* var. *hillii* 'Hills Weeping Fig' trees (Perkins Street), planted exotic street trees in some areas along Hunter and Scott streets, and exotic grasses and hedges. Some landscaping is also located along streets and in private open space. Generally, vegetation within and around the proposal site consists of scattered street trees and low shrubs in the former rail corridor. These provide some visual screening to adjacent properties.

12.2.2 Landscape character areas

Four landscape character areas were identified within the study area:

- Character area 1: Wickham Transport Interchange to Worth Place
- Character area 2: Cultural and legal precincts – Worth Place to Crown Street
- Character area 3: Crown Street to Pacific Street
- Character area 4: East of Pacific Street.

These landscape character areas were identified as having similar spatial or character properties, and similar landscape sensitivity. The landscape character areas are shown on Figure 12.2 and described in Table 12.1. Representative photographs of each landscape character area are also provided in Table 12.1. Further information is provided in Technical Paper 6.

12.2.3 Sensitive visual receiver viewing areas

As the proposal would be located within a highly developed and relatively flat urban environment, views of the proposal would be limited to those within the immediate vicinity of the proposal site. Sensitive visual receivers within the study area include:

- pedestrians, cyclists and motorists
- residents within apartment buildings or individual dwellings that adjoin and/or have clear views of the proposal site
- workers in commercial buildings that adjoin and/or have clear views of the proposal site
- users of recreational areas with views of the proposal site.

For the purposes of the assessment, the study area was divided into the following representative sensitive receiver viewing areas ('representative viewing areas') by grouping receivers with similar sensitivities located within similar visual environments:

- Viewing area 1 – Wickham Transport Interchange to Cottage Creek
- Viewing area 2 – Cottage Creek to Union Street
- Viewing area 3 – Union Street to Auckland Street
- Viewing area 4 – Auckland Street to Darby Street
- Viewing area 5 – Darby Street to Crown Street
- Viewing area 6 – Crown Street to Newcomen Street
- Viewing area 7 – Newcomen Street to Watt Street
- Viewing area 8 – Watt Street and Pacific Street to Zaara Street.

The representative viewing areas are shown on Figure 12.3 and described in Table 12.2.

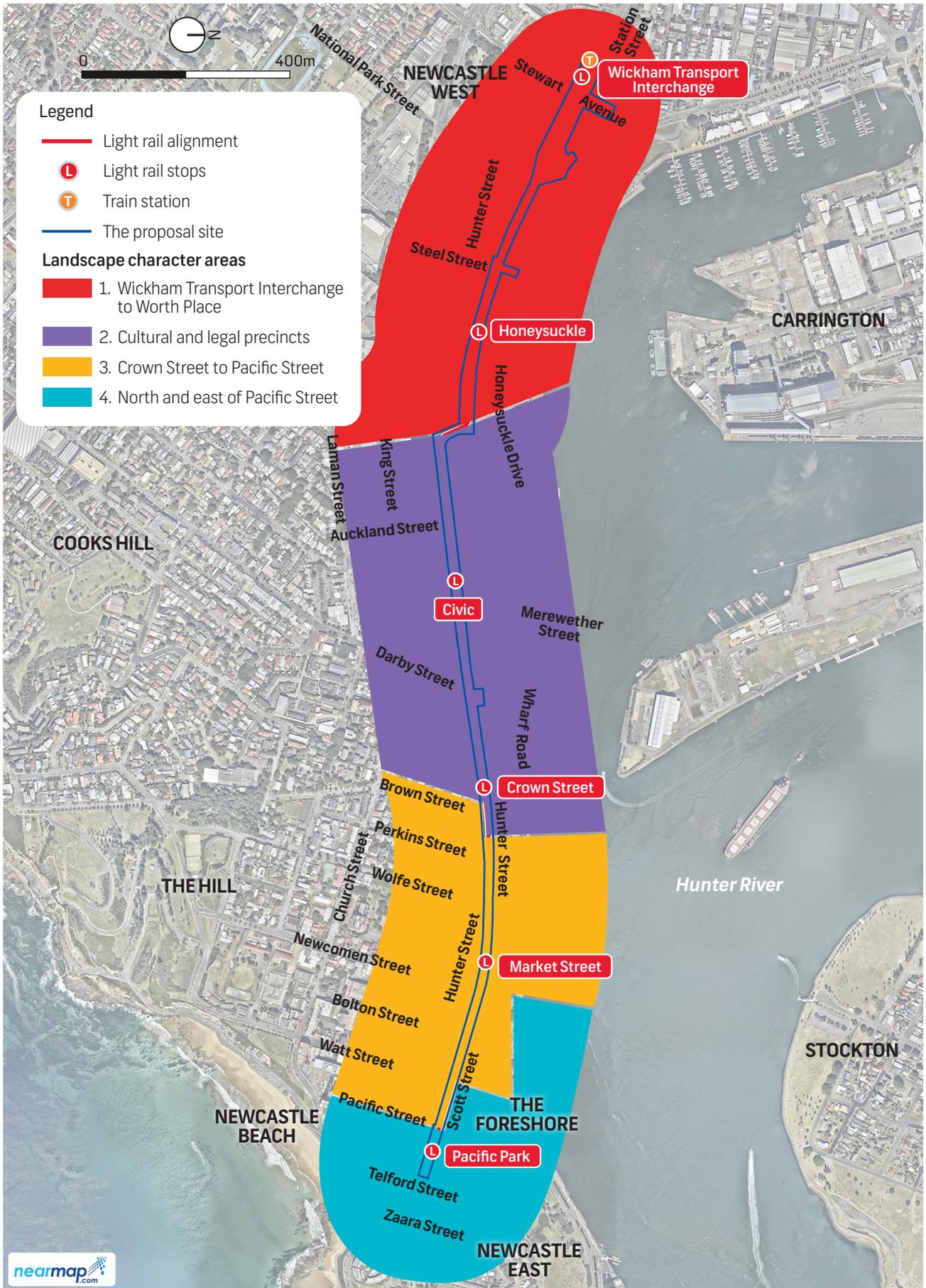


Figure 12.2 Landscape character areas

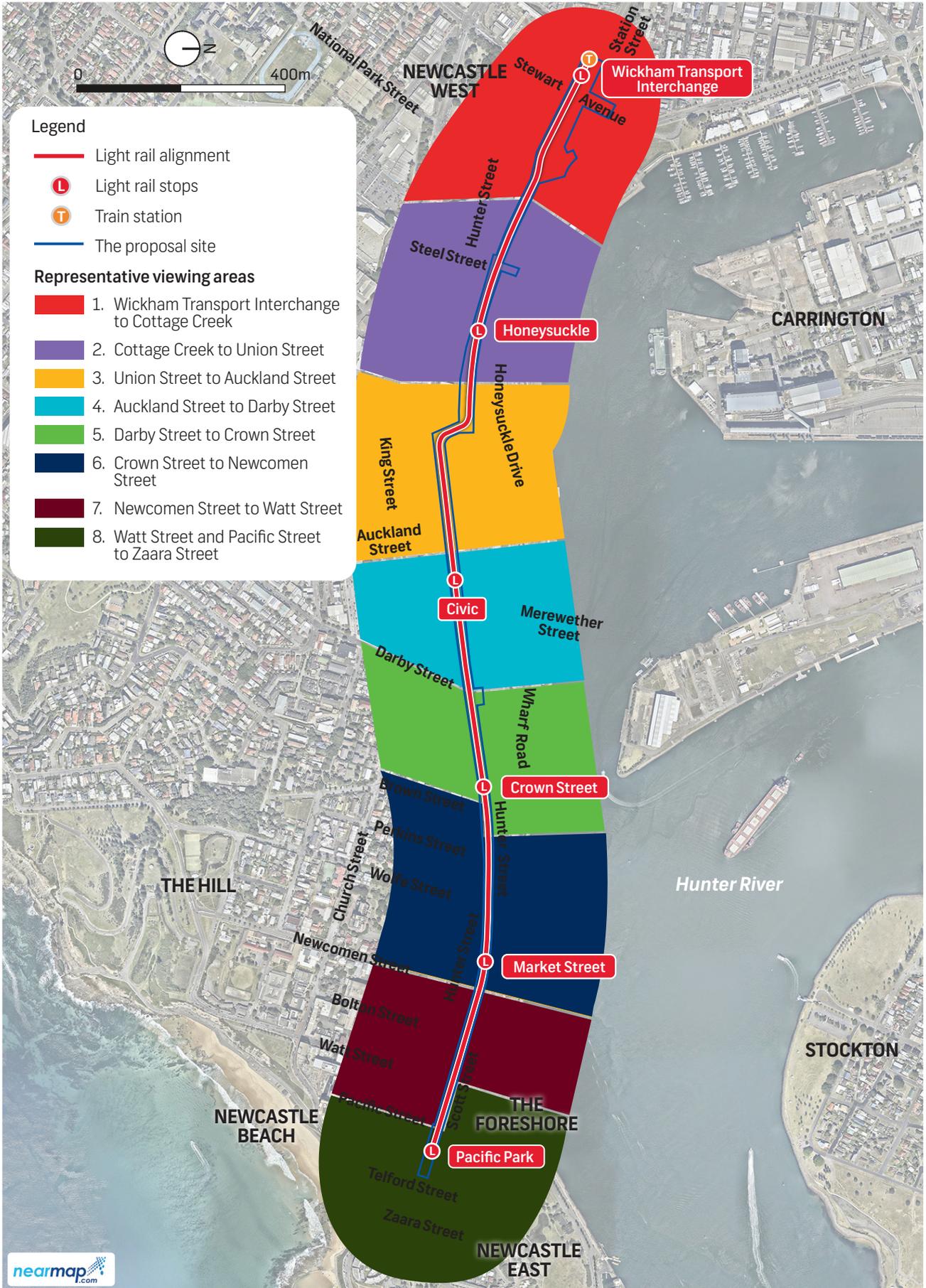


Figure 12.3 Representative viewing areas

Table 12.1 Landscape character areas

Landscape character area	Description	Sensitivity
<p>1: Wickham interchange to Worth Place</p>	<p>The area is characterised by a highly developed urban environment, and is bound by multiple parallel transport corridors (Honeysuckle Drive, the former rail corridor and Hunter Street).</p> <p>The surrounding urban form varies in scale and is generally defined by large scale and high rise (five storeys and above) development, a mix of uses, including residential, commercial, light industrial and education. The architectural expression and spatial definition varies, and there is a characteristic mix of older and newer built form.</p> <p>The public realm is largely dominated by traffic, parking and rail infrastructure uses.</p> <p>The former rail corridor (and Wickham Station) is fenced-off and typically 20 to 30 metres wide. There are a number of large vacant lots surrounding the area and the former rail corridor to the north. It is expected that, over time, high rise development will infill the existing vacant lots.</p>	<p>Low</p> <p>The highly developed urban environment of the area, the dynamic and transitory nature of the urban form, and the significant diversity of built form and activity mean that the area has a high capacity to accommodate change, and a low sensitivity to change.</p>
 <p>Character area 1: View east along Beresford Street</p>	 <p>Character area 1: View south at Worth Place</p>	
<p>2: Cultural and legal precincts – Worth Place to Crown Street</p>	<p>The area is characterised by a highly developed urban environment around a linear transport corridor. Hunter Street is a wide street with six vehicle lanes, pedestrian pavements, active street frontages and some street trees.</p> <p>The urban form typically consists of two storey Victorian shop fronts, larger medium-high rise commercial and civic buildings with active frontages, and some street trees. There are some high quality heritage architectural facades.</p> <p>The area is a hub for educational, cultural and legal activities. A number of buildings have cultural and heritage significance.</p>	<p>Medium</p> <p>The highly developed and evolving urban environment of the area, the mix of high quality architectural facades, the lower quality streetscape, around Civic Station and the cultural significance of the area mean that the area is likely to have a medium potential capacity to accommodate change and a medium sensitivity to change.</p>

Landscape character area	Description	Sensitivity
		
<p>Character area 2: View east along Hunter Street</p>	<p>Character area 2: View west along Hunter Street</p>	
<p>3: Crown Street to Pacific Street</p>	<p>The area is characterised by its highly developed urban form and reasonable level of coherence bound by multiple linear transport corridors and longer north-south vehicle connections.</p> <p>The street scale changes from large to medium in scale as Hunter Street becomes Scott Street, and the roadway narrows by about 10 metres.</p> <p>The character changes west of Crown Street when the street becomes bound on the northern edge by the former rail corridor.</p> <p>The northern edge of Scott Street is characterised by wide and long views across the former rail corridor. The southern edge of Scott Street is characterised by medium to high quality architectural facades including modern, heritage Victorian red brick, Art Deco and industrial.</p> <p>There are a number of heritage listed buildings in the area. The State heritage listed Newcastle Station forms a recognisable landmark that anchors the area.</p> <p>The streetscape progresses from medium quality in the west to high quality towards the east.</p>	<p>Medium</p> <p>The highly developed and evolving urban environment of the area, the mix of high quality and heritage listed buildings, the pedestrian scale of the area combined with its historical elements mean that the area has a medium sensitivity to change and has a medium potential capacity to accommodate change.</p>
		
<p>Character area 3: View south along Newcomen Street</p>	<p>Character area 3: View east along Scott Street</p>	
<p>4: East of Pacific Street</p>	<p>The area is characterised by a developed urban environment centred around a road corridor and its proximity to Pacific Park, Enterprise Park and the foreshore. The streetscape is relatively small in scale with narrow streets and residential and community services buildings and forms the gateway to a predominantly residential area to the east. The topography of the area is more varied, due to proximity to the Flagstaff Hill headland.</p>	<p>Medium to high</p> <p>The lower density fine grain urban form, prominent open spaces, a comfortable pedestrian scale and buildings with medium to high quality aesthetic value mean that the area has a low potential capacity to accommodate change and a medium to high sensitivity to change.</p>

Landscape character area	Description	Sensitivity
	<p>The lower density residential areas (some detached, some two storey terraced) and community facilities (such as the Joy Cummings Centre), coupled with the local roads and building setbacks of five metres or more, give the area a lower density 'small town' character.</p> <p>The character of this area is distinctive from the surrounding areas and the area provides a gateway to surrounding residential areas, the beach and significant historic attractions.</p>	



Character area 4: View northeast on Scott Street to Convict Lumber Yard



Character area 4: View east along Scott Street

Table 12.2 Representative viewing areas

Representative viewing area	Description	Visual receivers	Sensitivity
1: Wickham Transport Interchange to Cottage Creek	<p>This area includes the residential properties on Beresford Street and Bellevue Street as well as the surrounding commercial buildings.</p> <p>The bulky buildings to the east and west of Stewart Avenue, buildings along Beresford Street and the existing heavy rail infrastructure dominate this viewing area. Buildings largely screen the views of the former rail corridor from surrounding areas.</p>	Residents, pedestrians, cyclists, motorists and local workers	<p>Low – for general viewers (pedestrians, cyclists, motorists and local workers)</p> <p>Medium to high – for residents in the multistorey apartment buildings on Beresford Street</p>
2: Cottage Creek to Union Street	<p>This area is located in the area around the former rail corridor from Cottage Creek to Union Street. Views to the area are limited.</p>	Pedestrians, cyclists, motorists and local workers	Low – for general viewers
3: Union Street to Auckland Street	<p>This area is located from the junction of Union Street and Hunter Street to Auckland Street including Worth Place.</p> <p>The majority of the sensitive receivers in this viewing area would be pedestrians, cyclists, motorists moving through the area, and workers. There are a limited number of people in residential properties who would overlook the site in at a distance.</p>	Residents, pedestrians, cyclists, motorists and local workers	<p>Low – for general viewers</p> <p>Medium – for residents</p>
4: Auckland Street to Darby Street	<p>Views along Hunter Street are generally in an east–west linear direction confined by building height. Some north–south views are available along side streets that intersect Hunter Street.</p>	Recreational users, residents, pedestrians, cyclists,	Medium – for general viewers, and residents at a distance,

Representative viewing area	Description	Visual receivers	Sensitivity
	Views from this location are experienced by customers and workers, visitors to buildings in the Civic precinct, recreational users of Wheeler Plaza, and road vehicles and pedestrians passing through the area.	motorists and local workers	
5: Darby Street to Crown Street	Views along Hunter Street are generally in an east–west linear direction confined by building height. This area is viewed by pedestrians, cyclists, motorists moving through the area, and workers. There are also some views available to residents who would overlook the area at a distance.	Residents, pedestrians, cyclists, motorists and local workers	Low – for general viewers Medium – for residents
6: Crown Street to Newcomen Street	Views along Hunter Street are generally confined by building height to the south. To the north of Hunter Street and Scott Street, views are generally more open or filtered across the former rail corridor. Some north–south views are available.	Residents, pedestrians, cyclists, motorists and local workers	Low – for general viewers Medium – for residents
7: Newcomen Street to Watt Street	Views along Scott Street are generally confined by commercial buildings with high quality architectural facades and framed by mature street trees. Views from these locations are experienced by customers and workers of commercial premises, residents from balconies of the multi-storey residential building, road users, and pedestrians passing through the area.	Residents, pedestrians, cyclists, motorists and local workers	Low – for general viewers High – for residents
8: Watt Street and Pacific Street to Zaara Street	There are general views along Scott Street, high quality views from the Scott/Watt Street intersection to the foreshore reserve, and avenues of Norfolk Island Pines to the iconic Customs House and Convict Lumber Yard. This area also contains two parks and is within relatively close proximity to the beach. It is also viewed by people in residential properties who would overlook the site in close proximity.	Residents, pedestrians, cyclists, motorists and local workers	High – for general viewers and residents

12.3 Impact assessment

12.3.1 Construction

Summary of potential impacts

The proposal would generate temporary visual impacts during the construction period. These impacts would be experienced by sensitive visual receivers (including residents, pedestrians, cyclists, motorists and local workers) in the vicinity of the construction works and from the identified representative viewing areas. During construction, visible elements would include work sites, machinery and equipment, fencing, soil stockpiles, waste materials and partially constructed structures.

The potential visual impact of the proposal would depend on the nature and intensity of the construction works. The change in the visual environment would generally be experienced from a relative short distance. Visual impacts would also be more significant at locations where residential or other sensitive receivers have an unscreened view of the proposal site. However, the impacts would be temporary and limited to the construction period. In addition, the majority of the construction works would be viewed within the context of a highly developed and dynamic urban environment, where construction and associated works are frequent occurrences.

The areas with the most potential for visual impacts during construction include the sections of the proposal site along Beresford, Hunter and Scott streets; the areas around the western and eastern construction compounds; and the site for the stabling and maintenance facility. However, these impacts would be temporary and limited to the construction phase of the proposal.

There may also be potential for some light spill impacts associated with any lighting required to carry out night works and for driver safety. However, central Newcastle is generally well lit at night and additional lighting should not result in a significant increase in light spill. In addition, directional lighting would be used to minimise the potential for light spill.

The mitigation measures provided in section 12.4 would be implemented to minimise landscape and visual impacts during construction.

Summary of construction impacts on landscape character areas

Potential impacts on the identified landscape character areas are summarised in Table 12.3.

Summary of construction impacts on representative viewing areas

Potential impacts on the representative viewing areas are summarised in Table 12.4.

Table 12.3 Summary of potential construction impacts on landscape character

Landscape character area	Key works in area	Construction impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
1: Wickham Transport Interchange to Worth Place	<ul style="list-style-type: none"> removal of Wickham Station buildings operation of the western construction compound construction of the stabling and maintenance facility construction of light rail infrastructure in Beresford Street and the former rail corridor, including the Honeysuckle stop in the former rail corridor 	<p>Works would displace users and change circulation and access patterns and may alter building access. The existing station would become a construction site and, along with the adjacent construction compound, would be enclosed by fencing. These impacts would result in a temporary reduction in the quality of the landscape for the duration of the construction period.</p>	Large	Moderate
2: Cultural and legal precincts – Worth Place to Crown Street	<ul style="list-style-type: none"> construction of light rail infrastructure in Worth Place and Hunter Street, including the Civic and Crown Street stops construction of a new road crossing across the former rail corridor at Worth Place construction of the substations in the former rail corridor 	<p>The active construction zone would have hoarding around its perimeter. These activities and interventions would generate a change to the street landscape for the duration of the construction period. It is likely that the flow of pedestrian movements would be impacted by the construction works with diversion around the site causing impacts on the visual connectivity and legibility in this area. These works would displace users and may alter the circulation through the area. However, the works would be temporary, and would move along the proposal site during the construction period.</p>	Moderate	Moderate
3: Crown Street to Pacific Street	<ul style="list-style-type: none"> operation of the eastern construction compound construction of light rail infrastructure, mainly in Scott Street, including the Market Street stop removal of the pedestrian bridge near Market Street 	<p>The active construction zone would have hoarding around its perimeter. These activities and interventions would generate a change to the street landscape for the duration of the construction period. It is likely that the flow of pedestrian movements would be impacted by the construction works with diversion around the site causing impacts on the visual connectivity and legibility in this area. These works would displace users and may alter the circulation through the area.</p>	Moderate	Moderate

Landscape character area	Key works in area	Construction impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
4: North and east of Pacific Street	<ul style="list-style-type: none"> construction of light rail infrastructure in Scott Street, including the Pacific Park stop and terminus facility 	Works in the area would be undertaken close to a recreation area and within a finer grained and smaller scale urban environment. These impacts would result in a temporary reduction in the quality of the landscape which has a medium to high sensitivity to change. The works in this area would be highly localised.	Moderate	High-moderate to moderate

Table 12.4 Summary of potential construction impacts on representative viewing areas

Representative viewing area	Visible features	Construction impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
1: Wickham Transport Interchange to Cottage Creek	<ul style="list-style-type: none"> the western site compound machinery and construction works from the Wickham Transport Interchange along Beresford Street removal and construction activities at the existing Wickham Station site 	The proposal would be viewed as being characteristic of the existing rail infrastructure in an urban context and would have a moderate, short term impact on sensitive receivers in this area.	Moderate	Moderate-low (general) Moderate to high-moderate (residential)
2: Cottage Creek to Union Street	<ul style="list-style-type: none"> machinery and construction works along the former rail corridor construction of the Honeysuckle stop 	There would be limited opportunities to view the construction areas in the former rail corridor. The proposal would be viewed as being characteristic of the existing rail infrastructure in an urban context and would have a small, short term impact on sensitive receivers in this area.	Small	Low
3: Union Street to Auckland Street	<ul style="list-style-type: none"> machinery and construction works along the former rail corridor, Worth Place and Hunter Street 	The proposal would have a moderate, short term impact on sensitive receivers in this area. This would be particularly the case for when the construction works move from the former rail corridor to the street at Worth Place.	Moderate	Moderate-low (general) Moderate (residential)
4: Auckland Street to Darby Street	<ul style="list-style-type: none"> machinery and construction works along Hunter Street 	The proposal would have a moderate, short term impact on sensitive receivers in this area. The construction works would be within the road corridor and would cause some disruption to road users and the general streetscape.	Moderate	Moderate

Representative viewing area	Visible features	Construction impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
5: Darby Street to Crown Street	<ul style="list-style-type: none"> machinery and construction works along Hunter Street and in the former rail corridor (for the substations) construction of the Crown Street stop 	The construction works would be mainly within the road corridor and would cause some disruption to road users and the general streetscape.	Moderate	Moderate-low (general) Moderate (residential)
6: Crown Street to Newcomen Street	<ul style="list-style-type: none"> machinery and construction works along Hunter and Scott streets construction of the Market Street stop removal of the existing pedestrian bridge near Market Street the eastern site compound 	<p>The proposal would have a moderate, short term impact on sensitive receivers in this area. The construction works would be within the road corridor and would cause some disruption to road users and the general streetscape.</p> <p>The eastern construction compound would be located within the former rail corridor just west of Newcastle Station. This is already a degraded area with a lot of visual clutter. The presence of a construction compound within this changing urban environment would not be uncharacteristic.</p>	Moderate	Moderate-low (general) Moderate (residential)
7: Newcomen Street to Watt Street	<ul style="list-style-type: none"> machinery and construction works along Scott Street 	The proposal would have a moderate, short term impact on sensitive receivers in this area. The construction works would be within the road corridor and would cause some disruption to road users and the general streetscape.	Moderate	Moderate-low (general) High-moderate (residential)
8: Watt Street and Pacific Street to Zaara Street	<ul style="list-style-type: none"> machinery and construction works along Scott Street construction of the Pacific Park stop and terminus 	The construction works would be within the road corridor and would cause some disruption to road users and the general streetscape. Views to and from the adjoining park would also be temporarily impacted.	Moderate	High-moderate

12.3.2 Operation

Key features with the potential for visual impacts

Infrastructure proposed as part of the proposal and the key operational features are described in chapter 6 of the REF.

Once constructed, the potential visual impacts of the proposal would be mainly associated with:

- the presence of light rail vehicles in the street
- the new stops and associated infrastructure, including signage, shelters and furniture
- overhead wiring and poles along the route
- the stabling and maintenance facility at Wickham
- new traffic signals associated with road crossings and intersection changes
- removal of two pedestrian overbridges
- the substations
- new sources of lighting associated with the light rail vehicles, stops and the stabling and maintenance facility.

The artist's impressions included in Figure 12.4 to Figure 12.8 provide an indication of the appearance of some of the key features of the proposal.

Summary of potential impacts

The proposal would introduce a new moving vehicle into existing transport corridors, and would introduce new structures, mainly along Hunter and Scott streets. These changes would have most potential for impact during the early years of operation, and would be likely to be rapidly normalised as they become seen as part of the urban environment. The majority of the features associated with the proposal are already present in the urban environment (such as public transport stops, wiring, poles, stop furniture), and as a result, the general appearance of the proposal would be consistent with the existing urban form.

The proposal has the potential to both impact and benefit the surrounding landscape and visual receivers. The main impacts during operation would be associated with the new light rail alignment and infrastructure within the road corridor. A potential benefit of the proposal would be the increased pedestrian connectivity, including links across the former rail corridor, and opportunities for urban design improvements as part of the city centre renewal process.

Urban design considerations

As noted in section 6.4.1, the appearance and visual form of the key proposal elements have been, and would continue to be important considerations in the design process. The stabling and maintenance facility and the stops would be designed to be consistent with the existing character of the city centre and with any urban design masterplan prepared by UrbanGrowth NSW. The design of the key elements would continue to be refined during the detailed design phase. The final design would continue to take into account all relevant considerations, as listed in section 6.4.1.

As noted in chapters 1 and 5, the transport program aspects of the NUTTP (of which the proposal forms a key part) are an important part of the wider renewal of the Newcastle city centre. The proposal would play an important role in achieving the renewal of the city centre, reconnecting the Newcastle CBD to its waterfront and making it easier to move around the city centre. The removal of the existing pedestrian rail overbridges and the introduction of two new road crossings across the former rail corridor would improve the visual and pedestrian/vehicle connectivity across the former rail corridor.



Figure 12.4 Artist's impression – looking north west along Stewart Avenue from Beresford Street at the Wickham Transport Interchange



Figure 12.5 Artist's impression – looking north east across Steel Street south of Honeysuckle Drive at the light rail crossing



Figure 12.6 Artist's impression – looking east along Hunter Street from Auckland Street at the Civic stop



Figure 12.7 Artist's impression – looking east along Hunter Street at the Civic stop



Figure 12.8 Artist's impression – Looking south from Scott Street at the Pacific Park stop, across Pacific Park towards Newcastle Beach

The broader urban amenity considerations, including streetscape works and cycling considerations, would be subject to a separate assessment process at a later date.

Night time visual impacts

Operation of the proposal would introduce light and moving light rail vehicles to existing transport corridors. Visible features would include the illuminated carriage windows and headlights. Visual impacts would be minimised by the fact that the majority of the alignment is located in what is currently a highly trafficked roadway, already used by lit vehicles. Headlights on the light rail vehicles would be generally the same size and brightness as standard car headlights. The light rail vehicles would constitute a broader but less frequent, more predictable light source than the existing vehicle headlights.

Operation of the proposal would also introduce new stops with night lighting. The stops would be located in an area that is already well lit, and lighting would be designed to minimise the potential for light spill.

The lighting within the former rail corridor would be consistent with that in the road corridor. Lighting would be directional to minimise light spill.

Lighting at the stabling and maintenance facility would be designed to minimise the potential for light spill.

The mitigation measures provided in section 12.4 would be implemented to reduce landscape and visual impacts during operation.

Summary of operation impacts on landscape character areas

Potential impacts on the identified landscape character areas are summarised in Table 12.5.

Summary of operation impacts on representative viewing areas

Potential impacts on the identified representative viewing areas are summarised in Table 12.6.

Table 12.5 Summary of potential operation impacts on landscape character

Landscape character area	Key proposal features	Operation impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
1: Wickham Transport Interchange to Worth Place	<ul style="list-style-type: none"> • stabling and maintenance facility • light rail infrastructure in Beresford Street and the former rail corridor, including the Honeysuckle stop in the former rail corridor • new road crossings over the former rail corridor at Steel Street and Worth Place 	<p>This landscape character area is an existing transport hub with warehouse buildings located along Beresford Street. The existing Wickham Station buildings would be replaced with the stabling and maintenance facility.</p> <p>There would be limited changes to the character of this area, with some changes to function and movement during operation. There would be a loss of pedestrian connectivity across the former rail corridor (as noted in section 8.3). Vegetation along Beresford Street beside Wickham Station would also be removed (refer section 15.5).</p> <p>These impacts would result in a small reduction in the quality of the landscape which has a low sensitivity to change.</p>	Small	Low
2: Cultural and legal precincts – Worth Place to Crown Street	<ul style="list-style-type: none"> • light rail infrastructure in Hunter Street, including the Civic and Crown Street stops • new road crossing over the former rail corridor at Worth Place • substations 	<p>Operation of the proposal would introduce new moving vehicles (the light rail vehicles) and power poles/wires.</p> <p>The character and functionality of the area would be maintained but with amendments to the pattern of movement within the area.</p> <p>These impacts would result in a small reduction in the quality of the landscape which has a medium sensitivity to change.</p>	Small	Moderate-low
3: Crown Street to Pacific Street	<ul style="list-style-type: none"> • light rail infrastructure in Scott Street, including the Market Street stop • removal of pedestrian bridge at Market Street 	<p>Operation of the proposal would introduce new moving vehicles (the light rail vehicles) and power poles/wires.</p> <p>The character and functionality of the area would be maintained but with amendments to the pattern of movement within the area.</p> <p>These impacts would result in a small reduction in the quality of the landscape, which has a medium sensitivity to change.</p>	Small	Moderate-low

Landscape character area	Key proposal features	Operation impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
4: North and east of Pacific Street	<ul style="list-style-type: none"> light rail infrastructure in Scott Street, including the Pacific Park stop and terminus facility 	<p>During operation, the light rail would operate on a mixed road/rail corridor and would include overhead power infrastructure. This area has a high quality, smaller scale landscape with smaller buildings and park areas. It is expected that there would be a reduction in the landscape quality of this character area. There would be amendments to the functionality and the pattern of movement within the area.</p> <p>These impacts would result in a small reduction in the quality of the landscape, which has a medium to high sensitivity to change.</p>	Small	Moderate to moderate-low

Table 12.6 Summary of potential operation impacts on representative viewing areas

Representative viewing area	Key proposal features	Operation impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
1: Wickham Transport Interchange to Cottage Creek	<ul style="list-style-type: none"> stabling and maintenance facility light rail infrastructure in Beresford Street and the former rail corridor 	<p>The visible elements would have a small impact on sensitive receivers in this area. Stationary or moving light rail vehicles would present a frequent and temporary visual barrier but would be viewed within the context of a previously operating rail transport corridor.</p> <p>There may be some benefits associated with opening up of the view from Beresford Street towards the north with the removal of Wickham Station.</p>	Small	Low (general) Moderate to moderate-low (residential)
2: Cottage Creek to Union Street	<ul style="list-style-type: none"> light rail infrastructure in the former rail corridor including the Honeysuckle stop new road crossing over the former rail corridor at Steel Street 	<p>The visible elements would have a negligible impact on sensitive receivers in this area. There would be an increase in streetscape activation due to more pedestrians moving around the Honeysuckle stop.</p> <p>Stationary or moving light rail vehicles would present a frequent and temporary visual barrier but would be viewed within the context of a previously operating rail transport corridor.</p>	Negligible	Negligible

Representative viewing area	Key proposal features	Operation impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
3: Union Street to Auckland Street	<ul style="list-style-type: none"> light rail infrastructure in Worth Place and Hunter Street new road crossing over the former rail corridor at Worth Place 	<p>The visible elements would have a small impact on sensitive receivers in this area. There would be an increase in streetscape activation due to more pedestrians moving around.</p> <p>There would be visual impacts associated with the overhead power infrastructure and poles within the streetscape, and changes to the Hunter Street roadway.</p> <p>Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles (such as a bus or truck).</p>	Small	Low to moderate-low
4: Auckland Street to Darby Street	<ul style="list-style-type: none"> light rail infrastructure in Hunter Street including the Civic stop 	<p>The visible elements would have a small impact on sensitive receivers in this area. There would be an increase in streetscape activation due to more pedestrians moving around.</p> <p>There would be visual impacts associated with the Civic stop, overhead power infrastructure and poles, and changes to patterns of movement.</p> <p>Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles.</p>	Small	Moderate to low
5: Darby Street to Crown Street	<ul style="list-style-type: none"> light rail infrastructure in Hunter Street including the Crown Street stop substations in the former rail corridor 	<p>The visible elements would have a small impact on sensitive receivers in this area. Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles.</p>	Small	Low (general) Moderate-low (residential)
6: Crown Street to Newcomen Street	<ul style="list-style-type: none"> light rail infrastructure along Hunter and Scott streets including the Market Street stop 	<p>The visible elements would have a small impact on sensitive receivers in this area. There would be visual impacts associated with the Crown and Market Street stops, overhead power infrastructure and poles, and changes to patterns of movement.</p> <p>Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles.</p>	Small	Low (general) Moderate-low (residential)

Representative viewing area	Key proposal features	Operation impact summary	Magnitude of impacts	Significance of impacts (based on Figure 12.1)
7: Newcomen Street to Watt Street	<ul style="list-style-type: none"> light rail infrastructure along Scott Street 	<p>The visible elements would have a small impact on sensitive receivers in this area. There would be visual impacts associated with changes to the roadway, and from overhead power infrastructure and poles within the streetscape.</p> <p>Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles.</p>	Small	Low (general) Moderate (residential)
8: Watt Street and Pacific Street to Zaara Street	<ul style="list-style-type: none"> light rail infrastructure along Scott Street, including the Pacific Park stop and terminus 	<p>The visible elements would have a moderate impact on sensitive receivers in this area. There would be visual impacts associated with the Pacific Park stop, with overhead power infrastructure and poles within the streetscape, and changes to patterns of movement.</p> <p>Single and occasionally multiple light rail vehicles waiting at the Pacific Park stop would present a new visual feature in the streetscape, which may temporarily block views to and from Pacific Park.</p> <p>Stationary or moving light rail vehicles would present a frequent but temporary visual barrier, but these would be viewed as being of similar scale, form and character as existing larger vehicles.</p>	Small	Moderate

12.4 Mitigation measures

12.4.1 Detailed design and pre-construction

- The detailed design of all structures would involve consideration of appropriate design features, materials and treatments to ensure that the proposal:
 - integrates with the surrounding and proposed urban form
 - achieves the urban design objectives of the *Newcastle Urban Renewal Strategy*, the NUTTP and *Newcastle 2030*
 - minimises the potential for visual impacts
 - respects the character and amenity of the surrounding area.
- An urban design and landscaping strategy would be prepared as part of the detailed design. The strategy would consider:
 - Use of a high quality landscape buffers (with street trees and planting) where practicable along the corridor to help integrate the infrastructure with the context and improve the visual experience of passengers. Design of landscape buffers would be undertaken in consultation with Council and other stakeholders.
 - Strategic use of materials that blend, enhance and/or complement existing surfaces and improve visual coherence of the proposal and its context.
 - Options to help make the overhead wire/catenary system appear as an integrated part of the public domain.
 - The opportunity to combine several above ground street elements (lighting, traffic signals etc.) on common use poles to reduce visual clutter.
 - The use of materials, finishes, colour schemes and maintenance procedures including graffiti control for new walls, barriers and fences.
 - Strategic location of signage to maintain sensitive sight lines and avoid unnecessary intrusion into receivers' views, and to enhance legibility of the broader context.
 - The design of barriers (railings, fences or walls) required for safety to complement the existing visual environment.
 - The heritage significance of the Newcastle City Centre Heritage Conservation Area.
 - The *NSW Sustainable Design Guidelines* (TfNSW, 2014a).
 - Safety and security requirements, including CPTED requirements.
- Lighting for the proposal would be designed in accordance with *AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*. Lighting would be designed to minimise light spill into adjoining areas.
- Opportunities for community involvement in mitigating visual impacts during construction and operation would be explored in consultation with Council.
- TfNSW's Sustainable Design Review Panel would review the detailed design.

12.4.2 Construction

- A construction visual amenity plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to minimise the potential impacts on visual amenity. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

12.4.3 Operation

- Ongoing maintenance, service and infrastructure upgrades would consider the urban design objectives of the *Newcastle Urban Renewal Strategy* and the NUTTP, where relevant.

13. Socio-economic impacts

A socio-economic impact assessment of the proposal was undertaken by GHD.

A comprehensive technical report is available as 'Technical Paper 6 – Socio-economic Assessment' on the TfNSW website (www.transport.nsw.gov.au). A summary of the results of the assessment is provided in the following sections.

13.1 Assessment approach and methodology

The assessment involved the following:

- reviewing background information on the proposal and the socio-economic environment of the study area (Newcastle city centre)
- a site inspection to review local conditions
- analysis of available community survey data, including data and reports from the Australian Bureau of Statistics *Census 2011*, NSW Bureau of Crime Statistics and Research, Bureau of Transport Statistics, and Council
- preparing a profile of the existing community that may be impacted by the proposal
- analysis of the outcomes of community consultation, including that undertaken by UrbanGrowth NSW in June/July 2014 (Design Newcastle) and in August/September 2015 (Revitalising Newcastle)
- a desktop analysis of the potential impacts and benefits of the proposal, including the potential for both direct and indirect impacts on the community and businesses
- identifying measures to mitigate and manage the impacts identified.

13.2 Existing environment

13.2.1 Social/community characteristics

A summary of the key demographic, social and community characteristics of the study area is provided below, based on the social profile prepared for the assessment.

Information on the strategic planning context, including the *Newcastle Urban Renewal Strategy* and the NUTTP, is provided in chapter 5. The land use context is described in chapter 14.

Demographic

- Newcastle city centre had a population of about 4,000 people in 2011.
- The study area has a different demographic compared with other areas of Newcastle and the wider region, with a much higher incidence of single person households, couples without children, and group households.
- The average age is 35 years, with around 31 per cent of the population aged 50 years and over.
- Households consist mainly of single persons and couples without children, living in apartments and semi-detached dwellings.
- Almost 60 per cent of households are renting, suggesting a high turnover of residents.

Social infrastructure

- Numerous offices for various local, State and Australian Government service providers are located along or close to the proposal site.
- There are 36 social service providers located along or close to the proposal site, including personal counselling, employment, health and education services providers.
- Public spaces around the Newcastle foreshore provide a popular location for informal, recreation as well as large planned events.

13.2.2 Economic characteristics

A summary of the economic characteristics of the study area is provided below, based on the profile prepared for the socio-economic assessment of the proposal, and on the economic assessment prepared for the *Newcastle Urban Renewal Strategy* (Hill PDA, 2012).

- Within the Newcastle city centre, Hunter Street is the traditional retail main street, hosting a diversity of retail and commercial properties and social and government services, with the Civic precinct at its centre. Retail activity is concentrated on the Hunter Street Mall, which leads into public recreation areas near the beach, and at the Marketown shopping centre located to the south-west of the proposal site. Honeysuckle, located to the north of the proposal site, is a relatively new commercial precinct.
- As at the end of 2014, about 280 non-residential properties were identified adjacent to the proposal site. About 77 per cent of these are businesses, with 13 per cent not for profit or government social services, and about 10 per cent vacant commercial space.
- Newcastle has experienced growth in the knowledge industries, with the expansion of health, higher education, research centres, defence industries and professional and technical services. In 2011, the most common occupation in Newcastle was 'professionals' (25.7 per cent). The main employment sector in 2011 was 'health care and social assistance' (employing over 17 per cent of the workforce), followed by retail trade, education and training, and manufacturing.
- The development of the University of Newcastle's city campus has the potential to significantly contribute to residential demand in the city centre.
- The number of jobs in the city centre is forecast to increase by 52 per cent between 2006 and 2031, with an increase of 10,240 jobs over the period.

13.3 Impact assessment

The key potential socio-economic impacts of the proposal include:

- impacts to the overall connectivity of the study area, and access to and within the study area
- amenity impacts
- impacts to local businesses
- impacts to social infrastructure
- employment generation

These issues are considered in the following sections for both construction and operation.

13.3.1 Construction

Connectivity and access

As identified in chapter 8, construction of the proposal would result in temporary changes to connectivity and access for residents, visitors, customers, businesses and service providers along and around the proposal site. It may also affect other areas of the city where re-routed traffic may impact on a range of users. These impacts relate to:

- impacts to travel times due to congestion and uncertainty
- changes to access and amenity for pedestrians, cyclists and bus users
- loss of parking and loading zones.

As noted in chapters 7 and 8, the amount of on-street parking along Beresford, Hunter and Scott streets would progressively reduce as construction progresses. Loss of on-street parking has the potential to impact on ready access to services and businesses. This is most relevant for customers accessing service providers and businesses along these streets, and for deliveries to businesses and organisations fronting these streets.

In general, there would be changes to the movement patterns for pedestrians, cyclists and bus users around construction areas during construction. Bus stops would be offset from construction zones where required, the number of traffic lanes would reduce, and pedestrians and cyclists would be directed around construction areas where necessary. The active construction area would progressively move along Beresford, Hunter and Scott streets.

These potential impacts would be temporary in nature and would be managed by the implementation of comprehensive traffic, transport and access management measures contained in the CEMP. Construction traffic and access planning would minimise these impacts as much as possible, and would seek to optimise traffic flow around the proposal site.

Communication with potentially affected users and information provision would assist in reducing uncertainty and the impacts of changes in access and movement patterns. A comprehensive community and stakeholder awareness program would be implemented during construction (as outlined in section 4.5 and 16.3), which would assist in managing these impacts and communicating changes to relevant stakeholders.

Further information on the potential for traffic and access impacts is provided in chapter 8.

Amenity

Construction of the proposal has the potential to result in temporary impacts to amenity for surrounding residents, visitors, customers and employees, particularly those occupying buildings in close proximity to the proposal site, including those in:

- Beresford Street – due to the longer duration of works in this area, which includes the removal of Wickham Station and associated facilities, construction of the light rail alignment along the street, and construction of the stabling and maintenance facility on the site currently occupied by Wickham Station. Two residential apartment buildings overlook the proposal site in this area, and there is the potential for noise impacts (refer section 9.4).
- Hunter Street between Worth Place and Scott Street – construction would move along the road corridor in close proximity to surrounding businesses and developments, including those in the Civic precinct.
- Scott Street between Telford and Pacific Streets – construction would occur in a relatively narrow road corridor, in close proximity to surrounding businesses and residential apartment buildings.

These potential impacts, which include noise and vibration, visual amenity and air quality, are considered in chapters 9, 12 and 15 respectively. Implementation of a comprehensive approach to consultation, communication and environmental management during construction, together with a rigorous monitoring program, would assist in minimising the potential impacts on amenity. Further information on the approach to consultation and environmental management during construction is provided in chapter 16.

Approaches to mitigate the aesthetic impacts of construction would consider the input of the community and Council. This would include creating opportunities for engagement and expression through public art or other such measures to deliver social and aesthetic benefit.

Local business impacts

Impacts to local businesses would vary according to their location along the proposal site, the stage of works, the type of works, existing access arrangements, the nature of the business, and current business performance.

Parking impacts, changes to pedestrian and vehicle movement patterns, and changes to stopping locations as a result of construction has the potential to impact on businesses reliant on passing trade and accessible parking. Local workers and customers would experience an increase in competition for available parking spaces as a result of the parking losses resulting from the proposal.

While access to businesses surrounding the proposal site would be maintained during construction, there may be temporary changes to current arrangements and/or inconvenience to businesses and their customers. An emergency access route for emergency services or utilities vehicles would be maintained at all times.

Reduction in amenity could potentially discourage customers and clients from the work areas. This is more likely for businesses relying on pleasant environments for services such as outdoor dining, personal services and potentially health services.

A business and organisation management plan would be developed prior to construction in consultation with local businesses to identify the needs of businesses along and around the proposal site, and strategies to minimise the potential impacts of the proposal.

The proposal also has the potential to benefit some businesses. Businesses located in close proximity to the proposal site and/or those on access routes to the site, particularly those providing goods and services (such as retail shops, take-away shops and cafes), may experience a temporary increase in patronage as a result of the influx and proximity of the construction workforce to the study area.

Social infrastructure

Social service providers often serve the most vulnerable in communities, and those with potentially less ability to adapt to changes in their environments and circumstances.

During construction, social services along the proposal site and their customers/clients may be affected by access or amenity impacts. In particular, services at the following locations may be more sensitive to construction impacts:

- Near Worth Place where the proposal leaves the former rail corridor and enters the road corridor – there are a number of service providers in this location.
- Pacific Park stop - the Joy Cummings domestic violence resource centre is located close to the proposal site.

The business and organisation management plan would identify those organisations and clients most vulnerable to potential impacts, and develop approaches to address these risks. The plan would include actions such as communicating the timing and duration of construction activities, and any access changes.

Employment and economic impacts

Construction of the proposal would generate a number of construction related jobs that are likely to be filled both locally and from the broader region. The proposal would generate up to about 100 construction jobs which would benefit both the local and regional economy. These jobs are only limited to the workforce that would be directly employed to construct the proposal and do not include additional jobs or increased demand stimulated through the supply and delivery of materials or services. The industries which support the construction of the proposal would also experience economic benefits.

TfNSW is committed to creating local opportunities for employment and upskilling their workforce as an element of their sustainability strategy. This would form a component of the tendering process for a construction contractor.

13.3.2 Operation

Connectivity and access

A key focus of the *Newcastle Urban Renewal Strategy* and projects being implemented as part of the NUTTP activities in the Newcastle city centre is improving access and connectivity to and within the city centre, and from the city to the foreshore areas. The ability to access housing, employment, retail outlets, education, recreation and community services, can impacts on the quality of life of residents of a city.

The proposal would have the potential to generate positive impacts in terms of local access and connectivity, and it would support the renewal of the Newcastle city centre. The proposal would provide a viable alternative to cars for short trips within the Newcastle city centre, and has the potential to act as a catalyst for renewal and urban improvement activities in the city centre.

Positive impacts include:

- Increased permeability and connectivity within the city centre, with the proposal providing an effective and desirable distributor role, linking the new Wickham Transport Interchange at Wickham with important destinations and trip generators in the city centre.
- Provision of a modern, reliable, frequent and efficient public transport service within the city centre.
- Improved access to Newcastle Beach and better connectivity for residents in the area.

The proposal also includes the addition of a number of supporting pedestrian crossings in connection with the stops. These crossings would support the recent pedestrian crossings across the former rail corridor, improving access and connectivity between the various precincts in the city centre.

Beresford Street is proposed to change to a one way street in the westerly direction, which would change the access arrangements for businesses and residents in the street. Access to all residences and businesses would be maintained.

The potential impacts of access and traffic changes are likely to be balanced by improved pedestrian access and reduced congestion on Hunter and Scott streets, as well as a reduction in the overall number of buses in the city centre, and the potential for reductions in vehicular traffic.

Overall, the proposal would have the potential to improve the urban amenity and provide a legible, user-friendly transport service, which connects to key community, education, recreation, cultural and retail facilities in the city centre.

Amenity

Operation of the proposal has the potential to result in some impacts to the amenity of the community surrounding the light rail route and the stabling and maintenance facility, particularly those located in close proximity to the proposal site. These potential impacts include traffic, noise and vibration, and visual. These impacts are assessed in sections 8, 9 and 12 respectively.

Local business impacts

During operation, the main impacts to businesses would be as a result of loss of on-street parking for customers and loading zones for business servicing.

As noted in section 8.3, the proposal would reduce the availability of on-street car parking and loading zones around the proposal site, mostly as a result of the need to provide space for the light rail route on Hunter and Scott streets.

The number of parking spaces and loading zones that would be impacted are summarised in section 8.3. The importance of ready access to on-street parking would depend on the nature of individual business and the demand for/turn-over of the spaces that would be lost. As noted in section 8.4, strategies and options to address the loss of on-street parking and changes to the availability of loading zones would be developed during the detailed design phase in consultation with relevant agencies and local businesses.

The proposal would have the potential to create long term benefits for businesses in the vicinity of the proposed stop locations. Operation of the proposal, along with the increased connectivity across the former rail corridor provided by the pedestrian crossings installed in 2015, has the potential to increase the vibrancy and walkability of the city centre and foreshore areas.

Social infrastructure

Users of social infrastructure in the study area would benefit from the improved quality and provision of public transport services through the city centre. The proposal would provide the opportunity for better access to city centre community services and social infrastructure.

Changes in the availability of on-street parking may affect some users with a disability and less mobile customers using these services. However, light rail vehicles and stops would comply with disability codes of practice to enable the efficient boarding and alighting of less abled customers.

13.4 Mitigation measures

13.4.1 Detailed design and pre-construction

- Options to mitigate the reduction in availability of on-street parking and loading zones would be considered as detailed in section 8.4. Consideration of the options would include a review of opportunities to retain on-street disabled parking and/or prioritise parking for the disabled.
- A business and organisation management plan would be developed by TfNSW in consultation with affected stakeholders to better understand and manage impacts to businesses and organisations in the vicinity of the proposal. The plan would:
 - address construction and operation

- be developed in consultation with the Council, businesses, and local organisations and service providers
- take into account other developments and proposals in the city centre
- include access management plans which would establish existing servicing and delivery requirements and identify alternative routes and requirements
- identify strategies to maintain emergency access at all times
- take into account special events planned in and around the city centre during the construction period.
- As described in section 4.5, key stakeholders (including local businesses and the community) would continue to be consulted regarding the potential impacts of the proposal. Where practicable, measures to address these impacts would be incorporated into the design.
- TfNSW would continue to work with relevant stakeholders including Council to identify opportunities to integrate the design of the proposal with other city centre renewal activities, to improve access to local community services, and further enhance the public domain along the proposal site.
- The detailed design of the proposal would take into account CPTED principles, particularly in relation to the stops and the stabling and maintenance facility. The design would incorporate features to maintain the safety of passengers, employees and the general public. Stops would be designed to be safe and attractive places to wait for services and would (where feasible and appropriate) incorporate LED lighting technology, emergency calling capabilities and CCTV.
- Partnership opportunities would be investigated with local employment agencies to identify opportunities to generate local employment benefits consistent with the *NSW Sustainable Design Guidelines* (TfNSW, 2014).

13.4.2 Construction

- A construction communication management plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to communicate with and respond to the community and businesses. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.
- Access to local businesses, community services and social infrastructure would be maintained during construction in accordance with the findings of the business and organisation management plan. Where alternative access arrangements need to be made, these would be developed in consultation with relevant service providers, and communicated to businesses and service users.

13.4.3 Operation

- An operations communication plan would be designed and implemented prior to the commencement of operation to provide information about light rail operation. Information would be made available at each stop and key locations in the city centre, and would also be made available in languages other than English.

14. Land use and property

This chapter discusses the potential land use and property impacts associated with the construction and operation of the proposal. The chapter provides an overview of the existing land use characteristics within the study area and provides a baseline from which to consider potential impacts. The chapter also identifies the potential land use and property impacts of the proposal with respect to the construction and operation of the proposal.

14.1 Existing environment

14.1.1 Land use of the proposal site

Most of the proposal site is or has been used for transport purposes (road and rail). The operation of heavy rail services along the heavy rail corridor between Hamilton and Newcastle stations ceased in December 2014. Six temporary pedestrian crossings were installed across the former rail corridor in 2015. Three of these (at Steel Street, Kuwumi Place and Worth Place) cross the proposal site.

The majority of the proposal site is public land (road or rail corridor) managed by Council or NSW Government agencies.

14.1.2 Surrounding land uses

Characteristic of its inner urban location, the study area consists of a varied and relatively dense mix of land uses, including commercial, retail, residential, recreation/entertainment, community, health and education uses, and transport infrastructure.

The main land uses surrounding the proposal site are summarised from west to east below. Land uses surrounding the proposal site are shown (based on the land use zoning from the Newcastle LEP) in Figure 14.1.

Wickham Transport Interchange to Worth Place

- Wickham Transport Interchange and surrounding commercial/retail areas are located at the western end of the proposal site.
- A mix of residential and commercial uses front Beresford Street east of the Wickham Transport Interchange.
- The Honeysuckle redevelopment area adjoins the former rail corridor to the north.
- A mix of commercial, accommodation, education and retail uses are located on either side of Hunter Street to the south of the proposal site.
- The Hunter TAFE Hunter Street Campus and the Newcastle Community Health Centre are located on the northern side of Hunter Street and adjoin the former rail corridor.
- Hotels including the Ibis, Travelodge and Quest are located on either side of Hunter Street.
- A number of private carparks, including those associated with the Ibis, TAFE and KFC development directly adjoin the southern side of the former rail corridor.
- The land on which the proposal site is located is zoned SP2 Infrastructure (the former rail corridor and Stewart Avenue), B3 Commercial Core, and B4 Mixed Use.



Figure 14.1 Land use

Worth Place to the intersection of Hunter Street and Scott Street

- A mix of residential, commercial, community, and retail uses front Hunter Street to the north and south of the proposal site.
- The proposal site passes through the area known as the Civic precinct (broadly bounded by Auckland, King, Darby and Hunter streets) which includes:
 - Newcastle City Hall and Council offices
 - Civic Theatre
 - the University of Newcastle city campus development (NeW Space) and University House
 - the new Newcastle courthouse development (justice precinct).
- Newcastle Museum and the Honeysuckle area are located further to the north, on the northern side of the former rail corridor.
- The land on which the proposal site is located is zoned B3 Commercial Core (Worth Place and Hunter Street between Auckland and Darby streets) and B4 Mixed Use (other areas of Hunter Street).

Intersection of Hunter Street and Scott Street to Pacific Park

- The former rail corridor adjoins the northern side of Scott Street at the western end of this section.
- A mix of residential, commercial and retail uses front the southern side of Scott Street.
- Hunter Street Mall is located further to the south of the proposal site.
- The Harbourview complex and the Queens Wharf ferry wharf are located further to the north of the proposal site.
- Newcastle Station fronts Scott Street on the northern side of the proposal site near Watt Street.
- At the eastern end of the proposal site, Pacific Park adjoins the site to the south, and Scott Street adjoins the site to the north. Residential uses front Scott Street to the north of the proposal site. Residential uses are also located to the east of the proposal site.
- Newcastle Beach and Shortland Park are located further to the south.
- The land on which the proposal site is located is zoned B4 Mixed Use (Scott Street to just east of Pacific Street), and it adjoins land zoned RE1 Public Recreation (at Pacific Park).

14.2 Future land uses

14.2.1 Strategic planning

As noted in chapter 5, the *Newcastle Urban Renewal Strategy* provides a vision for the future development and use of land in the Newcastle city centre to achieve the strategy's renewal and revitalisation objectives.

The land use/place making initiatives provided by the strategy and the NUTTP have the potential to result in gradual but significant changes to the urban form of Newcastle's city centre, and the land use and activities surrounding the proposal site. These initiatives include:

- reshaping Hunter Street as Newcastle's main street and a key destination
- strengthening the Civic precinct as the main municipal, educational, and cultural hub of Newcastle

- positioning the western end of the city centre as the city's future CBD.

To reshape Hunter Street as the main street of the city, the strategy provides for:

- the use of Hunter Street to facilitate better connections between precincts within and across the city centre
- redeveloping the landholdings around the Hunter Street Mall to revitalise the mall
- focusing activity in nodes rather than dispersing it along the full length of the street.

The main activity nodes proposed by the strategy and promoted by the NUTTP are (as shown in Figure 14.2):

- the East End (at the eastern end of Hunter Street, including Scott Street, Hunter Street Mall and Queens Wharf)
- Civic (including the Civic precinct)
- the West End (at the western end of Hunter Street around the Wickham Transport Interchange).



Source: UrbanGrowth, <http://yoursay.revitalisingnewcastle.com.au/>

Figure 14.2 City centre activity nodes

The Newcastle LEP's land use zoning plan for the city centre was amended in 2014 to provide for the implementation of the *Newcastle Urban Renewal Strategy*. The amended zoning plan (with land uses as shown in Figure 14.1) provides for commercial hubs at the key activity precincts through commercial core zonings. It also provides for new residential and mixed use zones in and around the city centre to support the commercial hubs and provide activation and vibrancy. These amendments, summarised below, provide an indication of the potential future land uses and development areas in the vicinity of the proposal site:

- The commercial core zone was extended along and around Hunter Street and Stewart Avenue to strengthen the role of the West End as the main commercial precinct in the city centre. The zoning recognises the potential for the Wickham Transport Interchange to provide a catalyst for future commercial development in this area.
- The Civic precinct was rezoned (in the area bounded by Auckland, King and Darby streets and the former rail corridor) from mixed use to commercial core zone. This was

undertaken to recognise its current uses and its important role as a civic, educational and cultural hub within the city centre.

- The area bounded by Perkins, Hunter, King and Newcomen streets (north of Cathedral Park) was rezoned from commercial core to mixed use.
- The zoning of the southern side of Hunter Street, between Steel Street and Jubilee Lane, was changed to mixed use to support Hunter Street and the commercial core zone.
- The blocks opposite National Park (bounded by Parry, Ravenshaw, Bull and Union streets) at the southern edge of the city centre were rezoned R4 High Density Residential zoning, to reflect the high amenity of this location and suitability for residential land uses (with possible mixed use at the ground level).
- At the eastern edges of the city centre, the area around King, Bolton and Watt streets was rezoned (from mixed use) to high density residential.

As part of the NUTTP, UrbanGrowth NSW is currently investigating opportunities for the future use of the former rail corridor between Worth Place and Watt Street (including Newcastle Station). UrbanGrowth NSW is preparing an urban transformation concept plan ('concept plan') for the former rail corridor as well as surrounding areas. To enable the delivery of the NUTTP, UrbanGrowth NSW will be seeking to amend the existing zoning of the land. The proposed zoning amendments will form part of the delivery of urban transformation, comprising a package of transport, built form and public domain improvements in and around the former rail corridorlands.

14.2.2 Major developments

Major developments (proposed and underway) in the vicinity of the proposal site are summarised below.

Newcastle East End/Hunter Street Mall redevelopment

UrbanGrowth NSW and the GPT Group are proposing to redevelop their landholdings around the Hunter Street Mall. The proposed development, referred to as the East End project, covers a 1.66 hectare site located between Perkins, Hunter, Newcomen and King streets, including the two buildings on the northern frontage of Hunter Street at the junction with Market Street. The proposed development would involve:

- a mix of residential and retail/commercial uses designed to activate the city centre
- 565 apartments
- 4,900 square metres of retail space
- 2,700 square metres of commercial space
- improved connectivity through the relocation and extension of lanes and streets.

A staged masterplan application for the development was lodged with Council in May 2014. UrbanGrowth NSW and GPT worked closely with Council to resolve a number of concerns that Council and the community raised about the development. A revised development application was lodged with Council in November 2015. Development timeframes, if approved, are unknown, but may occur within the next five to 10 years.

University of Newcastle city campus (NeW Space)

The University of Newcastle is developing a city centre education precinct called NeW Space on a 7,017 m² site at the corner of Hunter and Auckland streets. The development will involve a 10 storey building including lecture theatres, teaching and learning spaces, office and retail spaces.

It will also involve refurbishing the adjacent University House and connecting it to the new building. More than 3,500 students and 400 staff are expected to occupy the campus from the beginning of the 2017 academic year, with student numbers expected to increase to around 4,500.

Planning approval was granted in February 2014 (modified August 2015). Construction commenced in 2014 and is scheduled for completion in late 2016.

Newcastle Courthouse

The new Newcastle Courthouse opened in February 2016 at the corner of Hunter and Burwood streets. The development is comprised of a seven storey, 12,000 m² building, which includes 10 courtrooms and two tribunal rooms. It will host sittings of the Supreme, District, and Local Courts.

18 Honeysuckle Drive, Newcastle

Doma Honeysuckle Pty Ltd is redeveloping a site at 18 Honeysuckle Drive. The development involves a 10 storey mixed use commercial and residential development. Planning approval was granted in August 2015, with construction commencing in late 2016.

14.3 Impact assessment

14.3.1 Construction

Direct impacts on land use would be limited to temporary land take and the short term presence of construction equipment, plant, vehicles and fenced work sites along the proposal site. During construction, the use of the land would change from transport corridors and vacant land to a construction site.

14.3.2 Operation

Direct impacts

The operation of the majority of the proposal would not result in any direct impacts on land use. The proposal would involve the continued use of transport corridors (road and rail) for transport purposes. It would result in the introduction of a new type of transport along the road corridors, and it would reinstate a transport use along the former rail corridor between the Wickham Transport Interchange and Worth Place.

As noted in section 6.4.4, some sites/portions of land would be acquired to undertake the proposal. The use of the sites proposed as the locations for the stabling and maintenance facility and the Worth Place turnout would change from vacant land (both zoned B3 Commercial Core) to transport infrastructure (light rail).

The site proposed for the substations is currently zoned for infrastructure use. The overall land use would not change, however the proposal would result in a change in the type of transport use (from vacant former rail corridor to an active transport use).

Indirect impacts

The proposal, along with the other initiatives proposed by the *Newcastle Urban Renewal Strategy* and the NUTTP, has the potential to have an indirect positive impact. According to the strategy, the proposal would play a key role in achieving the strategy's urban renewal and revitalisation objectives for the city centre. The strategy notes that the proposal would link the three priority development precincts (as shown in Figure 14.2) and improve connectivity to and within the city centre.

The proposal is one of a package of renewal initiatives which are proposed for their potential to positively impact on urban form, development, future employment and use of the city centre.

It is anticipated that the NUTTP, of which the proposal forms part, will create opportunities for increased population growth and demand for housing that currently do not exist in the city centre.

Potential indirect impacts on land use include:

- Increases in pedestrian movements around stop locations could provide opportunities for changes in the mix of, and/or intensification of activities along the route and around stops.
- The provision of a major public transport facility across the city centre linking to the Wickham Transport Interchange could promote retail and commercial development by providing access to businesses from a potentially larger customer base.

Potential impacts on the major developments proposed and underway in the city centre (including those outlined in section 14.2.2) include:

- Facilitating an increased intensity of land use and higher density residential development that would benefit from the residential and employment populations using the proposal.
- Encouraging ongoing refinement of planning controls that allow for increased population densities in the city centre.
- Providing the opportunity for employees, students, customers, clients and residents to better access developments on the sites that are currently being developed, assisting and/or improving the ongoing viability of these developments.

Overall, the proposal is anticipated to integrate positively with the initiatives proposed by the *Newcastle Urban Renewal Strategy* and the NUTTP, and the significant development projects that are proposed or underway, by providing a public transport facility that can meet the needs of the future users of these developments.

The proposal could provide a catalyst for future urban development along the proposal site (in conjunction with the changes to land use zoning noted in section 14.2.1) and could assist in providing the connectivity and amenity that would support investment in future developments.

In addition to the renewal sites identified, it is anticipated that a range of further smaller scale redevelopments could occur throughout the city centre to take advantage of the improved transport network.

14.4 Mitigation measures

14.4.1 Detailed design and pre-construction

- TfNSW would continue to consult with key stakeholders as outlined in chapter 4 to ensure the proposal continues to be designed to achieve consistency with the initiatives proposed by the *Newcastle Urban Renewal Strategy* and the NUTTP.
- All acquisitions would be undertaken in consultation with landowners and in accordance with the requirements of the *Crown Lands Act 1989* and the *Land Acquisition (Just Terms Compensation) Act 1991*.

14.4.2 Construction

No mitigation measures are required.

14.4.3 Operation

No mitigation measures are required.

15. Assessment of other environmental impacts

15.1 Overview

Chapters 8 to 14 address the key potential environmental impacts associated with the proposal. In addition to these potential impacts, a range of other inputs have been considered to develop a comprehensive environmental management framework for the proposal. These issues include:

- hydrology, water quality and groundwater
- geology and soils
- contamination and hazardous materials
- flora and fauna
- air quality
- services and utilities
- waste and resources
- climate change and sustainability
- hazards and risks
- cumulative impacts.

This section considers the nature of these issues and the management measures proposed to manage the potential impacts of the proposal.

Clause 228 of the Regulation lists, for the purposes of Part 5 of the EP&A Act, the factors to be taken into account when considering the likely impact of an activity on the environment. Appendix B considers the potential impacts of the proposal against these factors.

15.2 Hydrology, water quality and groundwater

15.2.1 Existing environment

Watercourses and drainage

The proposal site and surrounding area have been significantly modified by urban development. Cottage Creek flows through the western end of the proposal site via a concrete lined channel located to the north of Bellevue Street. The creek flows under Hunter Street and the former rail corridor via culverts, and discharges to the Hunter River under Honeysuckle Drive (refer to Figure 15.1 and Figure 15.2). At the nearest point, the Hunter River is located about 75 metres north of the proposal site.

The existing stormwater drainage system within and in the vicinity of the proposal site is assumed to be fully functional and would be investigated further during detailed design.

Flooding

Flooding information for the proposal site has been obtained from the *Draft Definition Design Report* (PB/Aurecon, 2014b) and the *Newcastle City-wide Floodplain Risk Management Study and Plan* (BMT WBM, 2012).

The proposal site is located within the Cottage Creek catchment. The Cottage Creek catchment covers an area of about 800 hectares and includes the suburbs of Merewether, Hamilton, The Junction, Newcastle West and Cooks Hill. The catchment, which drains to the Hunter River, is substantially developed and drained by concrete pipe and open channel drainage systems.

Flood risk

Newcastle has a long history of flooding, given that much of the city was developed on old wetlands and floodplains, and is located adjacent to the Hunter River and the ocean (BMT WBM, 2012). The Newcastle city centre is subject to flood risk as a result of river flooding, flash flooding and ocean flooding/storm surge.

Flooding information indicates that, during the two year average recurrence interval (ARI) storm event, flooding would occur on either side of Cottage Creek and along Wharf Road near Queens Wharf. Flood depths during this event are expected to be up to 200 millimetres (PB/Aurecon, 2014b).

Flash floods

Flash floods are considered the most hazardous due to the unpredictable and sudden onset of dangerous conditions (BMT WBM, 2012). The Newcastle city centre (including the proposal site) is prone to flash flooding due to its flat and relatively low-lying nature. During heavy rainfall, stormwater may pond in and around the proposal site. It is expected that overtopping of Cottage Creek and the surcharge of stormwater drainage networks may occur within 20 to 30 minutes of five year and higher ARI events (PB/Aurecon, 2014b).

As storm intensities increase, flooding deepens and extends westerly and easterly from Cottage Creek and Queens Wharf. For the one in 50 and the one in 100 year ARI events, flood levels between 0.5 and one metre above ground level can be expected along parts of the former rail corridor (refer to Figure 15.1).

The probable maximum flood (PMF) event is considered to be the worst case flood event for an area. The PMF represents extreme flooding conditions and defines the extent of flood prone/liable land. Maximum flood depths up to 1.5 metres above ground level could be expected along the proposal site during this event (PB/Aurecon, 2014).

With respect to risk to life hazards, the mapping associated with the Floodplain Risk Management Study indicates that the majority of the proposal site is classified as 'L2', defined as 'short duration flash flooding with no warning time in circumstances where there is an obvious escape route to flood free land with enclosing waters during the PMF which are suitable for wading or heavy vehicles ... on site flood refuge is not necessary and normal light frame residential buildings are appropriate.' (BMT WBM, 2012).

Flow paths/flood storage

With respect to the one in 100 year ARI flood impact category, the proposal site is crossed by a designated floodway (Cottage Creek) and areas of the proposal site are designated as flood fringe (BMT WBM, 2012) (refer to Figure 15.2). For the PMF flood, the majority of the proposal site is designated as flood fringe. The western end of the proposal site contains a number of designated floodways and an area of designated flood storage.

Coastal inundation

Coastal inundation associated with king tides and coastal processes occurs to a limited degree around Maryville, Wickham, Stockton and Carrington. Although the Newcastle city centre (including the proposal site) is largely protected from coastal inundation, the combination of heavy rainfall events and high coastal water can exacerbate flood levels (PB/Aurecon, 2014b).



Figure 15.1 100 year ARI flash flood

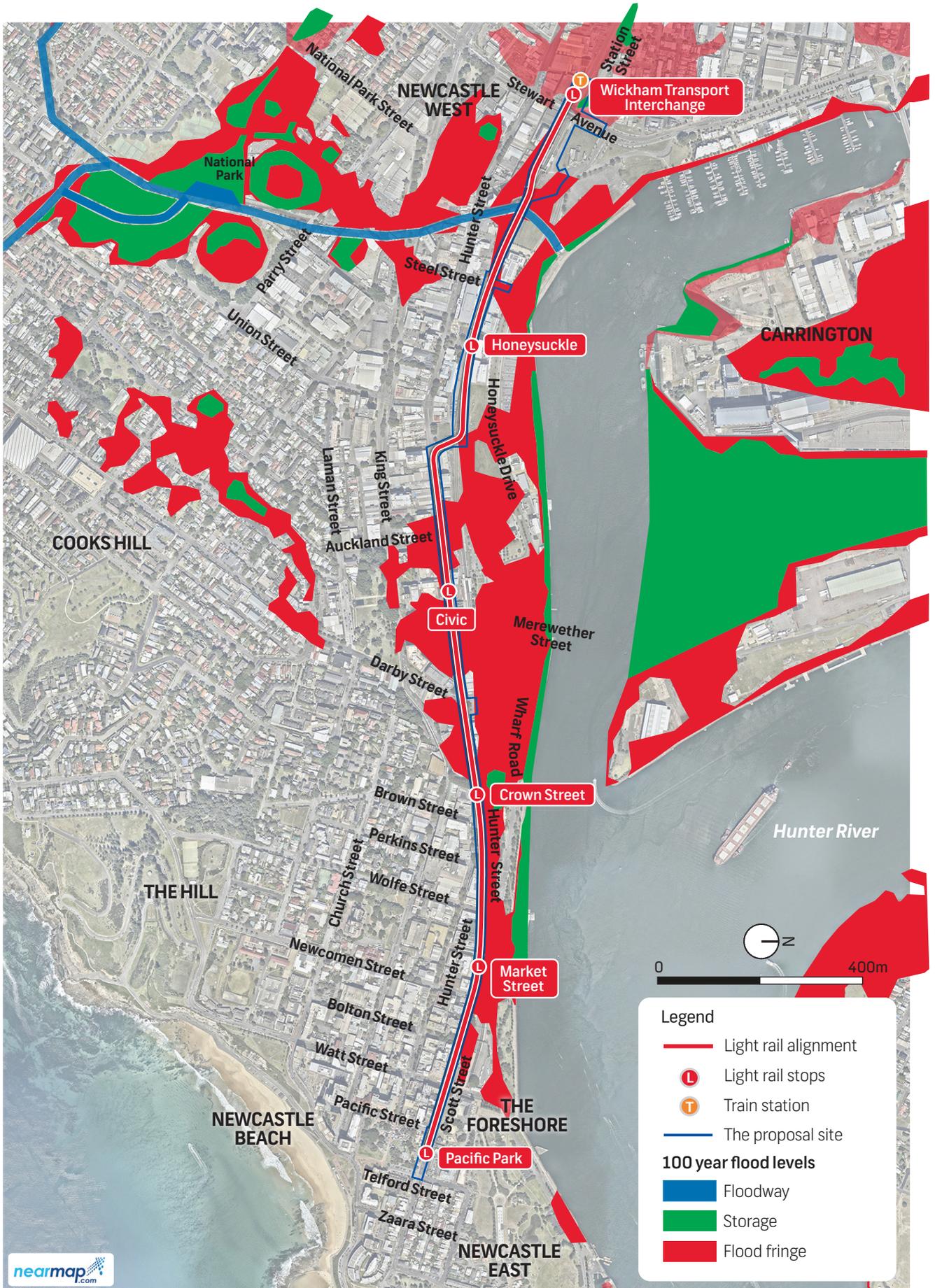


Figure 15.2 1 in 100 year event flood impact categories

Any flooding events from the ocean would initially be caused by backwater from Newcastle Harbour flowing through existing pipes and channels in the study area. If the water level in the harbour exceeded the ground level, overland flow could reach the proposal site. Tidal influence has been measured at numerous monitoring wells, particularly within the Honeysuckle precinct and Newcastle Station (PB/Aurecon, 2014b).

Water quality

Typical of most urban waterways, the main pollutants within Newcastle's waterways are gross pollutants, nutrients, erosion and sedimentation, heavy metals, litter and microbiological contamination (City of Newcastle, 2004). The responsibility for urban stormwater management within Cottage Creek is shared between Council and Hunter Water. The *Newcastle Stormwater Management Plan* provides a summary of water quality results for Cottage Creek (BMT WBM, 2012). The data indicates:

- dissolved oxygen concentrations do not appear to be an area of concern
- faecal coliforms rise quite sharply during rainfall events
- suspended solids concentrations rise during rainfall events
- phosphorous and nitrogen levels appear high compared to the Australian and New Zealand guidelines for fresh and marine water quality (the ANZECC guidelines).

Groundwater

During the geotechnical investigations undertaken as an input to the pre-concept design (PB, 2015) (refer to section 15.3), groundwater inflows were recorded within the former rail corridor at four test pits, at depths ranging from 1.5 to 2.3 metres. Outside the rail corridor, groundwater was recorded in all boreholes at depths ranging from 1.5 metres (0.35 m AHD) to 4.9 metres (2.7 m AHD) below ground level.

Groundwater levels are expected to change seasonally and be influenced by the tide and major rainfall events.

15.2.2 Construction impact assessment

Flooding and drainage

Blockages within a stormwater system can affect flood levels upstream and downstream. If inadequately managed, construction can result in temporary impacts to the behaviour of local surface water systems. These impacts could include a temporary loss of floodplain storage and temporary redistribution of flood flows as a result of the presence of stockpiles, obstructions, and works within flow paths. These impacts would be short term and would only be an issue if a flood event occurred during construction.

The risk of flooding and drainage impacts, and the significance of any impacts that may occur, would be reduced by implementing the mitigation measures provided in section 15.2.4.

Water quality

Construction of the proposal would involve disturbance of the ground surface. The main potential impacts to water quality relate to soil disturbance and runoff during construction. Pollutants such as sediment, soil nutrients and construction waste have the potential to mobilise and enter the stormwater system and Cottage Creek, particularly during high rainfall events.

Potential impacts associated with increased sediment loading include increased turbidity and an increased potential for the transport of contaminants bound to sediment particles. The transportation of contaminated soil from construction sites (if present) could also affect water quality if any contaminants escape containment measures.

Water quality impacts could also potentially occur during construction as a result of contamination by fuel or chemical spills from construction vehicles.

Although the proposal has the potential to temporarily reduce water quality from pollutants and run-off, it would not be expected to cause significant impacts to the overall condition of surrounding waterways. Construction is unlikely to result in any long term water quality impacts in the study area.

The risk of water quality impacts, and the significance of any impacts that may occur, would be reduced by implementing the mitigation measures provided in section 15.2.4.

Groundwater

Bored piling would be required to construct the stabling and maintenance facility and would be likely to intercept groundwater. Footings for other infrastructure (such as stops, power poles and the substations) would also potentially intersect groundwater. Groundwater inflow/seepage is expected during excavation (PB, 2015) and dewatering would be required.

A groundwater management plan would form part of the CEMP for the proposal (refer to section 15.2.4). Groundwater encountered during construction, would be pumped into a contained area, tested, and if necessary treated, before re-use, discharge or disposal.

15.2.3 Operation impact assessment

Hydrology, flooding and drainage

The proposal site would intersect existing stormwater drainage infrastructure and overland flow paths along the roadways. Flooding has the potential to impact on the operation of the proposal (for example, by preventing operation, causing damage or impacting on pedestrian access). The presence of infrastructure associated with the proposal has the potential to impact on local drainage, water flow paths and flood behaviour. Without adequate management of local drainage, the presence of stops and track slabs could increase upstream flood levels and impact road safety.

There is also the potential for a small reduction in the available flood storage capacity and a slight increase in runoff as a result of the increase in impervious surfaces (particularly the stabling and maintenance facility). However, these impacts are not likely to be significant, as the increase in impervious surfaces is likely to be minimal.

The proposal would also have the potential to change existing local drainage patterns and flows as a result of the need to make adjustments to existing drainage in the heavy rail and road corridors.

The proposal would be designed to ensure that it does not result in substantial changes to the local and regional hydrological environment, and it does not result in any increases to flood risk. Appropriate drainage to accommodate stormwater flows would be incorporated into the design of the proposal. Flood refuge for the proposal is provided at the Pacific Park stop and the stabling and maintenance facility, which are above the flash flood level (refer to Figure 15.1). The potential for impacts to, and as a result of, the proposal would be mitigated by ensuring the design is consistent with current design standards. With the adoption of relevant design criteria and standards, no major changes to flow quantities and velocities are likely.

Water quality

Infrastructure

Potential impacts to water quality could include contamination of stormwater by run-off (for example, by oils, greases, general run-off from impervious surfaces, and gross pollutants) from stops, the stabling and maintenance facilities, and the substation site. The proposal would be designed to ensure there is minimal potential for water quality impacts as a result of operation. Bunding would be incorporated into the design to contain any chemical spills or leaks from the stabling and maintenance facility and substation site.

Light rail vehicles

Small amounts of metals, oils and particulates would be generated by the operation of the light rail vehicles (for example, particulates generated by wheel/rail contact and braking). This would not result in the generation of large volumes of contaminants or significant water quality impacts.

Friction modifiers or gauge face lubricants may be used in the vicinity of rail curves to reduce the likelihood of wheel squeal occurring. A range of petroleum-based and biodegradable products are available for use. TfNSW asset standards require that any lubricant application areas are fitted with track pad mats to control the dispersion of excess lubricant to the environment and that the mats are replaced every six to twelve months. This would reduce the potential for water quality impacts.

The vehicles would spray small quantities of sand on the rails ahead of the main traction units to increase friction and improve contact in wet conditions. The application of sand to the rails may generate small amounts of material that might be carried in suspension if this activity coincides with or follows heavy rain. The resultant impact on water quality and drainage systems is not expected to be significant given the small quantities that would be used.

Groundwater

There would be no impacts on groundwater during operation.

15.2.4 Mitigation measures

Detailed design and pre-construction

- The proposal would be designed to ensure there is minimal potential for water quality impacts as a result of the operation of the proposal. Bunding would be incorporated into the design to contain any chemical spills or leaks from the stabling and maintenance facility and substation sites.
- The proposal would be designed to ensure compliance with the *Floodplain Development Manual* (DIPNR, 2005) which includes a requirement to not increase flood levels above existing levels.
- All track drainage would be designed to meet relevant TfNSW standards and the requirements of *Australian Rainfall and Runoff* (Engineers Australia, 1999).

Construction

- A soil and water quality management plan, including groundwater and flood management sub-plans, would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to minimise the potential impacts on flooding and water quality. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

- Road and rail stormwater drainage would be reinstated as required, in accordance with Council and/or Roads and Maritime requirements.

Operation

- Operational protocols would be developed by the operator to ensure customer safety and protect infrastructure and light rail vehicles in the event of flooding.

15.3 Geology and soils

15.3.1 Existing environment

The results of geotechnical studies undertaken for the definition and pre-concept designs (PB/Aurecon, 2014b; PB, 2015) are summarised in the following sections. Information on contamination is provided in section 15.4.

Topography/landform

The study area is located on a flat, low-lying coastal plain associated with the Lower Hunter Plain region, with rising sedimentary terrain immediately south of the Newcastle city centre. Slopes are generally less than two per cent and local relief is less than one metre, with elevations of about two metres near Stewart Avenue.

Geology

The study area is underlain by quaternary deposits and Newcastle coal measures of late Permian age. The quaternary deposits comprise gravel, sand, silt, clay, marine, and freshwater deposits. The Newcastle coal measures comprise sandstone, siltstone, claystone, conglomerate, shale, coal, and tuff from the Lambton sub-group.

Soil types

The proposal site is underlain by the Hamilton soil landscape group to the west, and the Killingworth soil landscape group to the east. The Hamilton soil landscape group is characterised by localised seasonal waterlogging, groundwater pollution hazard, high permeability, strong acidity, and non-cohesive soils. The Killingworth soil landscape group is characterised by high water erosion hazard, localised foundation hazard, localised seasonal waterlogging, sodic/dispersible soils of low wet strength, and strong acid soils of low fertility.

The bedrock ranges in depth from about 40 metres below ground level at Cottage Creek, to about six metres below ground level along Hunter Street.

The soils overlying bedrock generally consist of:

- alluvial sands and clays with relative densities/consistencies that generally increase with depth
- a potential paleo channel infilled with medium dense to dense sand/gravel
- residual stiff to very stiff clay (typically one to two metres thick) under the alluvial material and overlying highly weathered rock
- a layer of fill, typically ranging from about 0.5 to two metres thick, up to a maximum of 3.5 metres thick near Cottage Creek, generally consisting of sandy material with gravels/silts and building waste (concrete, bricks, tiles, slag etc).

The water line near the city centre has changed significantly over the past 100 years. In particular, significant filling has occurred east of Perkins Street. Recent investigations along Wharf Road indicate the presence of variable fill ranging in depth from four to eight metres below ground level.

Acid sulphate soils

Acid sulphate soils mapping for the study area indicates that there is a high probability of acid sulphate soils within the former rail corridor, with the potential to occur at about one to three metres below ground level. There is a low probability of acid sulphate soils around Hunter and Scott Streets, with the potential to occur at depths greater than three metres below ground level.

Twenty-six soil samples taken as part of the geotechnical assessment (PB, 2015) were screened in the field and sent to the laboratory to be tested for potential and actual acid sulphate soils. The results concluded that acid sulphate soils are likely to be encountered at depths greater than two metres below ground level, in the vicinity of the boreholes located in the former rail corridor between Steel Street and Worth Place, and in Hunter Street between Worth Place and near Darby Street.

Mine subsidence

The study area has been previously undermined to extract coal from the Newcastle coal measures. Mapping prepared by the NSW Mine Subsidence Board indicates that the area between Bellevue Street and Newcomen Street is variously subject to the Mine Subsidence Board's category A, B and C restrictions to surface development (refer to Figure 15.3). Specific requirements for the assessment and management of sites within each category are specified by the Mine Subsidence Board.

Review of the mapping indicates that the section of the proposal site that runs along Hunter Street, between Worth Place and Market Street, is underlain by mine workings or lies within the area of influence of mine workings.

The remainder of the proposal site is not undermined. However, some areas lie within the area of influence of some workings, and could be affected by tilts, strains and cracking if subsidence of the workings were to occur.

TfNSW would consult the Mine Subsidence Board prior to the commencement of construction and seek advice in relation to their requirements for the proposal. Previous consultation with the Board indicates that these restrictions generally only apply to multi-storey developments, and would be unlikely to apply to the proposal.

15.3.2 Construction impact assessment

Construction of the proposal would involve disturbing the ground surface and subsurface. No basement excavations are proposed. The majority of excavations are expected to be less than one metre deep.

If inadequately managed, excavation and stockpiling activities could have the following impacts:

- erosion of exposed soil and stockpiled materials
- dust generation from excavation and vehicle movements over exposed soil
- an increase in sediment loads entering the stormwater system and/or local runoff.

These impacts are considered to be minimal, as they would be temporary and short-term. The potential for impacts would be managed by the implementation of the measures provided in section 15.3.4.

It is expected that the majority of spoil would be used as backfill. Excess spoil not required or able to be used as backfill would be stockpiled in a suitable location. It would either be reused elsewhere (if appropriate) or removed from the proposal site, and disposed of at an appropriately licensed facility.

Other potential impacts include:

- exposure of acid sulphate soils for shallow foundations, buried services and deep foundations
- excavation instability, particularly in mine subsidence areas.

The exposure of acid sulphate soils can have detrimental impacts on water quality and structures. Soils excavated from nominated potential acid sulphate areas would be subject to the provisions of an acid sulphate soil management plan. Once acid sulphate soils have been treated, depending on the results of testing, they can either be reused on site, or disposed of at an appropriate facility.

In relation to the mine subsidence, it is noted that the mine subsidence assessment prepared as part of the geotechnical assessment (PB, 2015) was based on records from the last 100 years. The assessment recommends that further investigations are required during the detailed design phase to fill identified data gaps and determine if any older convict workings underlie sections of the proposal site.

15.3.3 Operation impact assessment

Operation of the proposal is not likely to result in any significant impacts on soils, landscape, topography or geology. The risk of soil erosion during operation would be minimal as all areas affected by construction would be self-contained, sealed or rehabilitated and landscaped.

15.3.4 Mitigation measures

Detailed design and pre-construction

- Further geotechnical assessment would be undertaken during detailed design to confirm and assess the location and condition of former mine workings and sub-grade conditions.
- Those aspects of the proposal located within the Newcastle Mine Subsidence District would be designed in accordance with any requirements provided by the Mine Subsidence Board.

Construction

- A soil and water management plan, including an acid sulphate soil management sub-plan, would be prepared as part of the CEMP. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

Operation

- During any maintenance work where soils are exposed, sediment and erosion control devices would be installed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

15.4 Contamination and hazardous materials

15.4.1 Existing environment

A search of the NSW EPA's contaminated land register (record of notices and notified contaminated sites) undertaken by GHD on 24 March 2015 did not identify any registered contaminated sites within the proposal site. The following sites are located close to the proposal site:

- 50 Honeysuckle Drive, Newcastle – this site has been voluntarily remediated as part of the Honeysuckle development
- 26-28 Honeysuckle Drive, Newcastle – reclaimed land
- 313-317 Wharf Road, Newcastle – car park
- 40 Stevenson Place, Newcastle – other industry
- Scott Street, Newcastle - gasworks
- 113 Parry Street, Newcastle West - former Mobil service station.

Investigations undertaken for UrbanGrowth NSW by AECOM in 2014 and 2015 included a review of 25 previous contamination investigations in the vicinity of the proposal site. Key issues identified included:

- asbestos (chrysotile) was found in soil samples at Wickham Station
- elevated concentrations of metals were found in groundwater around Wickham and Newcastle stations
- a former petrol station was located on the corner of Scott and Watt Streets (decommissioned in the 1980s)
- sources of contamination (hydrocarbons, heavy metals) were identified around Newcastle Station
- contaminated fill material was found between Civic and Wickham stations
- underground storage tanks were found north of Wickham Station
- asbestos fragments were noted, and it was considered likely that underground asbestos piping is located in the area north of Wickham Station
- hydrocarbon contamination of fill, and copper and zinc levels which exceeded the relevant criteria, were identified at 352-356 Hunter Street.

The geotechnical and contamination investigation undertaken for the pre-concept design (PB, 2015) involved testing samples taken from 33 locations. The results of testing indicated that:

- Levels of benzo(a)pyrene (a PAH found in coal tar) exceeded the health investigation level criteria for commercial/industrial uses at two locations – at borehole number 9, which was located at Worth Place, and at borehole number 15, which was located at Telford Street to the east of Pacific Park).
- Levels of benzo(a)pyrene exceeded the ecological screening levels at 10 locations.
- Heavy metal concentrations exceeded the health investigation level criteria for lead at one location (at borehole number 7), and for copper at three locations (at test pit 5 (located at Wickham Station), and at borehole numbers 11 (located at Hunter Street opposite Crown Street) and 17 (at Hunter Street opposite Newcomen Street)).
- No other contaminants were detected at concentrations above the analytical limit of detection.

- Ecological screening and investigation levels were established for the top two metres of soil along the proposal site. While a number of exceedances were noted in the contamination report, these exceedances were considered to be a result of regional filling practices and are not necessarily confined to these site boundaries.
- There were no reported detections of asbestos. Visual observations of the test pit logs did not identify any fragments in any of the boreholes undertaken.

Waste classification of the soil samples was undertaken as part of the contamination investigation in accordance with the waste classification guidelines (EPA, 2014). Most samples were classified as general solid waste. The three samples where exceedances of the health investigation level criteria were identified (for benzo(a)pyrene and lead) were classified as restricted solid waste/hazardous waste. It is noted that this classification is preliminary and is a conservative estimate based on the laboratory results.

The following potentially hazardous and/or contaminated material may be located within the Wickham Station buildings:

- equipment containing oil
- asbestos-containing materials
- synthetic mineral fibre
- lead-based paint
- lead dust.

15.4.2 Construction impact assessment

Excavation and construction vehicles

Excavation may disturb contaminated soils and hazardous materials present in soil. If inadequately managed, the disturbance of any areas of contamination has the potential to impact on human health and water quality. Potential off-site impacts would be minimal as the proposal would only disturb soils within the existing rail and road corridor where access is restricted.

With respect to the identified exceedances of the health investigation level criteria (for benzo(a)pyrene and lead) identified by the contamination report at two locations samples, it is noted that the proposal would only involve works in the vicinity of one of these locations (at Worth Place). The contamination investigation report (PB, 2015) concluded that:

- Further health investigation and evaluation is required if material excavated at these locations is to remain on-site.
- Appropriate measures would need to be included in the CEMP (refer section 15.4.4) to manage contact with soil at the two locations where contamination was identified.
- Contact by contractors with the material at these locations would be managed through the implementation of a CEMP.
- Some hydrocarbon odours may be encountered during construction at these locations. Consideration would need to be given to the time material was left stockpiled and exposed during the proposed works to minimise this potential impact.
- Asbestos would be analysed as part of final waste classification for any soil to be excavated for disposal, as the presence of any asbestos contamination cannot be discounted even though it was not detected during sampling.

- The main potential ecological impact would be in relation to the success of any future landscaping where there is direct contact between the plants and soil. No off-site ecological impacts were predicted.

Hydrocarbon spills and leaks from construction vehicles have the potential to contaminate soils.

The measures provided in sections 15.4.4 and 16.3 would be implemented to manage these potential risks.

Removal of Wickham Station

Potentially hazardous and/or contaminated material may be encountered during the removal works. These materials have the potential to result in health impacts for construction workers and the general public if works are not undertaken using appropriate methods. The mitigation measures outlined in sections 15.4.4 and 16.3 would be implemented to ensure that impacts of hazardous materials are minimised. All waste would be collected and stored on the site prior to disposal in accordance with the *Waste Classification Guidelines* (EPA, 2014).

15.4.3 Operation impact assessment

Operation and maintenance activities at the stabling and maintenance facility would make use of a variety of lubricants and chemicals. In the event of any accidental spills or leakage, these materials could result in the contamination of soils and migration of contaminants to groundwater. However, as noted in section 15.2.4, bunding would be incorporated into the design of the facility to minimise the potential for these impacts. Potential operational impacts would be further reduced by including appropriate hazardous material procedures in the operator's environmental management system.

15.4.4 Mitigation measures

Construction

- A contamination and hazardous materials plan would be prepared as part of the CEMP. An outline of the requirements for the CEMP, including a list of management measures to be incorporated to minimise the potential for contamination impacts and incidents, is provided in section 16.3. This would include measures to manage contact by contractors with contaminated materials and the management of any hazardous materials and asbestos encountered during construction.

Operation

- The proposal would be managed in accordance with the operator's environmental management system.
- The operator's environmental management procedures would include hazardous materials handling and management procedures to minimise the potential for impacts associated with any chemical spills and leaks. These would include procedures for managing spills, and the refuelling and maintenance of vehicles/equipment. These procedures would adequately address activities at the stabling and maintenance facility, as well as other general maintenance of infrastructure associated with the proposal.

15.5 Flora and fauna

15.5.1 Existing environment

A desktop assessment was undertaken to determine the likelihood that any threatened flora and fauna species, populations and ecological communities would be present within or in the vicinity of the proposal site. This involved searches of relevant databases within a search area radius of 10 kilometres.

The results of the desktop assessment were confirmed by a site inspection. The purpose of this inspection was to identify whether any native vegetation or potential habitat (for threatened or migratory biota listed under the TSC and/or EPBC Acts) were present within or near the proposal site.

Database results

The database searches indicate that two threatened ecological communities, 24 threatened flora species, 78 threatened fauna species, and 71 migratory species have been previously recorded or are predicted to occur within the search area. A review of species profiles for these threatened species indicates that there is no suitable habitat within the proposal site for threatened flora and fauna.

A review of previous vegetation mapping indicates that there are no native vegetation communities within the study area.

The following weeds are known to occur within the heavy rail corridor:

- exotic perennial grasses, such as Rhodes grass, red natal grass and kikuyu
- exotic vines, such as asparagus fern and morning glory
- noxious weeds including lantana, crofton weed, Mexican poppy, mother of millions and Mossman River grass.

Inspection results

The proposal site is located in a highly modified urban environment and has low ecological significance. Vegetation in the proposal site is limited to exotic vegetation and planted street trees in various locations, including along Beresford Street, Worth Place, Hunter Street and Scott Street.

Any fauna inhabiting the study area would be common to urban environments and is unlikely to include threatened or migratory species. There are no aquatic habitats within or immediately adjoining the proposal site.

15.5.2 Impact assessment

Construction

Construction of the proposal would require the removal of about 20 street trees and shrubs in the vicinity of Wickham Station (both north and south of the station) and one street tree in the median of Worth Place (see Figure 15.4). These trees are unlikely to represent important fauna foraging habitat. All other street trees along Hunter and Scott streets would be retained. No threatened flora or ecological communities would be removed. No potentially significant impacts to threatened flora and fauna have been identified.

Operation

There would not be any impacts associated with the operation of the proposal.



Figure 15.4 Location of street trees that may be impacted by the proposal.

15.5.3 Mitigation measures

Construction

- A vegetation management procedure would be prepared as part of the CEMP to provide specific measures for the street trees that would require removal, as well as those that would be retained but are close to construction works. Trees that would be removed during construction would be replaced in accordance with the *Vegetation Offset Guide* (TfNSW, 2012) and in consultation with Council. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

Operation

- Operational procedures would be developed to manage any offset plantings, if required.

15.6 Air quality

15.6.1 Existing environment

As outlined in the *Lower Hunter Ambient Air Quality Review of Available Data* (OEH, 2012), air quality in the Newcastle LGA is generally good and meets the standards set by the National Environment Protection (Ambient Air Quality) Measure (NEPM) made under the *National Environment Protection Council (New South Wales) Act 1995*. The report also identifies that industrial, commercial and transportation sources are all significant contributors to adverse air quality in Newcastle.

The closest air quality monitoring station to the proposal site is located at the Newcastle Sportsground, about one kilometre south of the proposal site. Data collected at this station is considered to be representative of ambient air quality in the study area.

A review of published data collected from this monitoring station over the past five years indicates that the NEPM standards have been met for the recorded pollutants and no exceedances of the NEPM standards have been recorded, with the exception of particulate matter (PM₁₀). Concentrations of PM₁₀ were observed to exceed the 24-hour standard on 13 days during 2008, and on one day in 2009. It is likely that these exceedances were associated with regional pollution events such as smoke from bush fires or dust storms.

15.6.2 Construction impact assessment

Air quality impacts associated with construction would mainly result from dust generated during excavation. Other dust sources may be produced by material handling activities associated with trackform excavation and movement of construction vehicles on unsealed surfaces. Wind erosion of uncompacted surfaces, such as stockpiled material, could also cause localised emissions of dust.

Dust has the potential to impact on the amenity of people using local facilities, occupying nearby properties or passing the proposal site (such as workers, nearby residents, and pedestrians/cyclists). Due to the relatively low intensity of construction, the small amount of earthworks required, and the relatively short duration of construction works in any one area, the potential for adverse dust impacts is considered to be minimal.

The operation of construction plant, machinery and vehicles may also lead to short term increases in exhaust emissions in the study area. However, these impacts would be relatively minor due to the limited number of construction vehicles and the existing urban nature of the study area and other surrounding influences on air quality (such as car traffic and rail movements).

15.6.3 Operation impact assessment

The proposal would not result in significant impacts on local air quality during operation. As the light rail vehicles would operate using electricity, there would not be any significant point source emissions from vehicles.

Particulate emissions

Operation would generate minor particulate matter emissions, which would be mainly caused by:

- Wheel and rail wear – wear from wheels on rails would cause very low levels of emissions of metal particulates as the wheels and rail wear with use.
- Traction sanding involving the deposition of sand between the wheels and the rails to provide additional traction if required (for example, for stopping during wet weather) - modern sanding systems involve only a targeted application of sand at the contact point to minimise excessive sand deposits.

These particulate emissions would be relatively minor and would not significantly impact local air quality.

Gaseous emissions

Maintenance of the proposal and activities at the proposed stabling and maintenance facility would have the potential to generate minor gaseous emissions from vehicles and equipment. These emissions would be associated with the combustion of fuel (diesel and petrol) in construction plant, vehicles and machinery, and fugitive emissions from fuel and chemicals stored at the stabling and maintenance facility.

Any gaseous or fugitive emissions would be intermittent and transient in nature, and would be managed through the application of standard mitigation measures.

15.6.4 Mitigation measures

Construction

- A construction air quality management plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to minimise the potential impacts on air quality. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

Operation

- All light rail vehicles would be regularly maintained to ensure efficient operation.
- Street sweeping of the alignment would be undertaken regularly and in the event of any excessive build-up of material.
- Maintenance service vehicles and equipment would be maintained and operated in accordance with the manufacturers requirements.

15.7 Waste and resources

15.7.1 Legislative requirement

TfNSW is committed to ensuring responsible management of waste and the reuse of such waste through appropriate measures, in accordance with the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act 2001*. The resource management hierarchy principles in order of priority as outlined in the *Waste Avoidance and Resource Recovery Act 2001* are:

- avoidance of unnecessary resource consumption
- resource recovery (including reuse, reprocessing, recycling and energy recovery)
- disposal.

By adopting the above principles, TfNSW encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.

15.7.2 Construction impact assessment

Resource use

Construction of the proposal would involve the use of a number of resources, including:

- resources associated with the operation of construction plant and equipment (fuel and electricity)
- construction water (for concrete mixing and dust suppression)
- fill required to meet design levels
- concrete and paving materials
- materials required for the light rail system (vehicles, rail)
- materials required for the supporting infrastructure (substations, stabling and maintenance facility, signage, signals etc)
- landscaping.

The resources required are not currently limited in availability. However, materials such as metal and fuel are non-renewable and would be used conservatively. Excess spoil, not suitable for reuse, would be disposed of in accordance with safeguards and mitigation measures outlined in section 15.7.4. The management measures outlined in section 15.7.4 would assist in minimising the amount of resources required for construction.

Waste generation

Construction would have the potential to generate the following wastes:

- spoil from excavation
- surplus concrete, asphalt, bricks and materials
- roadside and rail materials (fencing, guide posts, guard rails etc)
- utility adjustments - such as electrical cabling from installation of wiring
- possible industrial waste such as lubricating oils, hydraulic fluids and cleaning agents
- heavy rail infrastructure removed from the former rail corridor (ballast, rails, signals etc)
- vegetation

- wastewater
- general litter, including glass, plastic, metal and paper waste
- redundant erosion and sediment controls.

Potentially contaminated material and/or hazardous spoil and materials may also be encountered during construction (refer to section 15.4).

Careful planning of construction activities would ensure that the volume of surplus materials is minimised and disposal is undertaken in accordance with relevant guidelines and legislation. The potential to reuse materials would be investigated during detailed design.

15.7.3 Operation impact assessment

Only a relatively small quantity of waste would be generated during operation. This would mainly relate to maintenance and repair activities. Wastes would include wastewater, oils, replacement ballast, cleaning agents, and landscaping maintenance wastes. Light rail customers may also generate small amounts of general waste and litter at stops.

The *NSW Sustainable Design Guidelines* (TfNSW, 2014a) (refer to section 15.8.2) includes materials and waste as a sustainability theme, with the objective of meeting or exceeding prevailing waste management standards. The measures listed in section 15.7.4 would be implemented to manage waste during operation.

15.7.4 Mitigation measures

Detailed design and pre-construction

- Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.

Construction

- A waste management plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to minimise and appropriately manage waste. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

Operation

- The proposal would be managed in accordance with the operator's environmental management system and the *Waste Classification Guidelines* (EPA, 2014).

15.8 Sustainability, climate change and greenhouse gases

15.8.1 Approach

This section considers the application of sustainability principles to the proposal, and the opportunities to achieve TfNSW's sustainability targets and outcomes. It considers the TfNSW *Newcastle Light Rail Sustainability Strategy*, the *NSW Sustainable Design Guidelines* (TfNSW, 2014a) and the ISCA Infrastructure Sustainability Rating Tool. A sustainability assessment of the proposal against the *NSW Sustainable Design Guidelines* was undertaken. The results of the assessment are summarised in this section.

15.8.2 Sustainability

Sustainability in TfNSW

Sustainability in TfNSW is underpinned by the *Transport Environment and Sustainability Policy Framework* (the Framework). The Framework is a collective and coordinated approach to deliver the NSW Government's environmental and sustainability agenda across the transport cluster (TfNSW, RailCorp, Roads and Maritime, and Sydney Trains). The Framework is outcomes based and seeks to improve TfNSW's environmental sustainability performance.

All government projects are also required to comply with the *Government Resource Efficiency Policy* (GREP). The aim of the GREP is to reduce the NSW Government's operating costs and lead by example by increasing the efficiency of the resources it uses, specifically energy, water, waste and clean air.

TfNSW applied the *NSW Sustainable Design Guidelines* (TfNSW, 2014) and ISCA Infrastructure Sustainability Rating Tool to the proposal. A dedicated sustainability strategy has also been developed by TfNSW for the delivery of this proposal. These are discussed in more detail below.

NSW Sustainable Design Guidelines

The TfNSW approach to sustainability is underpinned by a series of themes and objectives which define the approach to the delivery of sustainable assets. The *NSW Sustainable Design Guidelines* (TfNSW, 2014) are divided into seven sustainability themes (with several sub-themes) and include compulsory and discretionary initiatives in relation to:

- energy and greenhouse gases
- climate resilience
- materials and waste
- biodiversity and heritage
- water
- pollution control
- community benefit.

The guidelines encompass sustainability initiatives relevant to stations, transport interchanges, commuter car parks, maintenance facilities, civil infrastructure, tunnels, and light rail.

Compulsory initiatives may relate to a corporate target or are considered to be fundamental to the delivery of sustainable assets. If a compulsory initiative is considered to apply, then it must be completed. A discretionary initiative may not be practical for a particular project or may be the most appropriate initiative to meet a sustainability outcome. Written justification must be provided if a discretionary initiative has not been selected for implementation.

Projects can achieve a score of bronze, silver, gold, or platinum based on their selection of discretionary sustainable initiatives.

ISCA Infrastructure Sustainability Rating Tool

The ISCA Infrastructure Sustainability Rating Tool aims to:

- Provide a common national language for sustainability in infrastructure.
- Provide a vehicle for consistent application and evaluation of sustainability in tendering processes.

- Help in scoping whole-of-life sustainability risks for projects and assets, enabling smarter solutions that reduce risks and costs.
- Foster resource efficiency and waste reduction, reducing costs.
- Foster innovation and continuous improvement in the sustainability outcomes from infrastructure.
- Build an organisation's credentials and reputation in its approach to sustainability in infrastructure.

The rating tool can be applied to many different infrastructure projects including light rail. Ratings can be undertaken on a design, as built drawings, and operation of a project. An infrastructure project is assessed in terms of how it performs in each of 15 categories that are grouped into six themes in infrastructure sustainability. These include:

- management and governance
- using resources
- emissions, pollution and waste
- ecology
- people and place
- innovation.

Depending on the initiatives and performance of a project across each theme, it will achieve a score from 1 to 100 corresponding to a rating level of commended, excellent or leading.

Newcastle Light Rail Sustainability Strategy

The guiding principles in the TfNSW *Newcastle Light Rail Sustainability Strategy* are based on:

- a whole of life approach
- alignment with the NUTTP sustainability objectives
- the Framework
- the *NSW Sustainable Design Guidelines*
- the ISCA Infrastructure Sustainability Rating Tool.

The guiding principles are expressed across the following sustainability themes:

- management and governance
- climate risk
- energy and greenhouse gas emissions
- resource use – waste and materials
- water
- pollution and water sensitive urban design
- community well-being
- workforce
- city connections
- innovation.

The strategy identifies the following four themes as having the highest priority for the delivery and operation of the proposal:

- management and governance
- energy and greenhouse gas emissions
- workforce
- sustainable procurement.

The strategy outlines key recommendations and requirements for embedding sustainability across each of the above themes.

Assessment

The sustainability assessment undertaken during the definition design stage identified both compulsory and discretionary initiatives that would be adopted within each discipline across the proposal, and when these initiatives need to be considered in the design process. The results indicate that a gold rating under the *NSW Sustainable Design Guidelines*, and an Excellent Rating under the Infrastructure Sustainability Rating Tool, are achievable for the proposal.

The sustainability assessment would be updated as the development of the proposal progresses. The Sustainability Manager for the proposal would undertake review and consultation with the relevant members of the design team throughout the development process. This process would evaluate where initiatives are being implemented, in addition to promoting continuous improvement and innovation. If a sustainability initiative has not been incorporated, an explanation as to why it has not been incorporated into the proposal would be required to be documented as part of the design process.

The Sustainability Manager would also be responsible for ensuring project delivery is aligned with the *Newcastle Light Rail Sustainability Strategy* and all relevant TfNSW policies.

15.8.3 Climate change

Climate change refers to the warming temperatures and altered climate conditions associated with the concentration of greenhouse gases in the atmosphere. These changes to future climatic conditions have the potential to impact existing and new infrastructure.

In 2010, the NSW Government published climate change projections for NSW. This included projections for the Hunter region and the likely impacts the region would experience.

Assessment

Temperature changes and associated impacts, including altered rainfall patterns, sea level rise, and severe weather events, may adversely affect the delivery and operation of the proposal. These risks may affect the proposal objectives both directly and indirectly. Potential impacts may include flooding, equipment malfunction, and a reduction in track and structural integrity.

A climate change risk assessment would be undertaken during the detailed design stage, in accordance with the TfNSW climate risk assessment methodology. The assessment would identify potential direct and indirect climate change impacts on the proposal, and associated risks for the proposed infrastructure. Extreme, high and medium risks would be identified, and mitigation measures would be implemented to reduce the impacts of climate change.

15.8.4 Greenhouse gas emissions

The proposal would generate greenhouse gas emissions through the operation of plant and machinery during construction, and the use of equipment and light rail vehicles during operation.

The consumption of fossil fuel is still a necessary requirement for vehicles and equipment during construction. However, significant reductions can be made by optimising work activities and logistics. A reduction in fuel consumption may also be achieved by the use of more efficient plant and vehicles. Newer vehicles and plant models are typically more fuel efficient than older models. Avoiding prolonged idling when equipment is not in use would assist in reducing fuel consumption and the potential for noise impacts.

The use of biodiesel in plant and equipment could assist in reducing the generation of greenhouse gases. Biodiesel blends (diesel that has a percentage of the fuel replaced with biodiesel) also have the potential to reduce greenhouse gas emissions. However, this would depend on a number of factors, including the origin of the biodiesel feedstock, and manufacturers specifications.

Overall, greenhouse gas emissions resulting from construction would be relatively low and unlikely to significantly contribute to overall greenhouse gas emissions.

A greenhouse gas and carbon footprint assessment would be undertaken during the detailed design stage, in accordance with the *NSW Sustainable Design Guidelines* and the TfNSW Carbon and Energy Reporting Tool. This assessment would evaluate the sources of greenhouse gas emissions during the construction and operation phases, including:

- direct emissions from construction activities, such as the combustion of fuel in construction plant/vehicles and vegetation clearing
- indirect emissions from the use of electricity on-site and the disposal of waste
- embodied energy (and associated greenhouse gas emissions) in construction materials (the energy and resources that were consumed to produce a particular construction material)
- emissions produced from day-to-day operations.

The greenhouse gas assessment would identify a range of mitigation measures to reduce the volume of greenhouse gas emissions, which would be implemented during construction and operation.

TfNSW would aim to offset 100 per cent of operational electricity emissions through the purchase of accredited renewable energy suppliers.

15.8.5 Mitigation measures

Detailed design and pre-construction

- Design of the proposal would be undertaken in accordance with the *NSW Sustainable Design Guidelines* (V3.0, TfNSW, 2014). Initiatives recommended by the sustainability assessment to achieve a rating level of 'gold' would be implemented.
- The detailed design of the proposal would aim to achieve an 'excellent' rating using the ISCA Infrastructure Sustainability Rating Tool.
- The sustainability initiatives would be regularly reviewed, updated and implemented throughout the design development phases.
- The feasibility of using grassed tracks along sections of the alignment would be investigated.
- A climate change risk assessment would be developed during detailed design
- A carbon footprinting exercise, compliant with ISO 14064 Part 2 (Greenhouse gases – project level), would be undertaken in accordance with TfNSW's Carbon and Energy Reporting Tool and the *NSW Sustainable Design Guidelines*. The carbon footprint would

be used to inform decision-making in design and construction. Standard carbon coefficient values would be used for construction material and fuel usage.

- Opportunities to reduce operational greenhouse gas emissions would be investigated during detailed design. These would include the initiatives documented in the sustainability assessment.
- The feasibility of using renewable energy for the construction of the proposal would be investigated.

Construction

- Construction of the proposal would be undertaken in accordance with the *NSW Sustainable Design Guidelines*. The sustainability initiatives would be regularly reviewed, updated and implemented throughout the construction program.
- Regular sustainability reporting (and corrective action where necessary) would be undertaken during construction to demonstrate how sustainability has been incorporated.

Operation

- The sustainability initiatives would be regularly reviewed, updated and implemented throughout operation.
- TfNSW would aim to offset 100 per cent of operational electricity emissions through the purchase of accredited renewable energy suppliers.

15.9 Hazards and risks

15.9.1 Construction impact assessment

The main categories of potential hazards and risks associated with construction are:

- environmental hazards and risks – as identified in chapters 8 to 15 of this REF
- health and safety hazards and risks – including any activity or outcome that may affect the health and/or safety of construction personnel or the community.

Environmental hazards and risks associated with the construction of the proposal would be manageable through the development and implementation of environmental management measures as part of the CEMP.

The presence of construction activities can create a risk for people moving in the vicinity of construction sites and vehicles.

NSW workplace safety laws require construction sites to have adequate site security, which includes appropriate fencing. All construction work would be isolated from the general public. The construction contractor would ensure that construction sites are secure at all times, and would take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements. Construction sites would be managed in accordance with the requirements of the WorkCover Authority of NSW and the *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2011*.

Potential risks associated with exposure to contaminated soils and hazardous materials are considered in section 15.4.

15.9.2 Operation impact assessment

Potential hazards and risks to workers and the general community during operation would include:

- risks to pedestrians as a result of collisions with light rail vehicles:
 - at stops, crossings and within the running areas
 - while pedestrians are accessing stops
- risk to other road vehicles as a result of collisions between light rail vehicles and other vehicles:
 - at crossings and intersections
 - in the shared running section
- risks to passengers, including as a result of:
 - collisions
 - fire
 - safety risks at stops.
- other fire and life safety risks, such as impacts on evacuation paths from surrounding buildings, security risks, unauthorised access etc
- general worker health and safety issues for drivers and maintenance staff, including as a result of:
 - accidental interactions with overhead wiring
 - the handling, storage, use and disposal of chemicals and other potentially hazardous materials
 - general injuries eg at the stabling and maintenance facility
 - electromagnetic fields from the proposed substations and overhead wiring.

The above hazards and risks would be managed by undertaking the design with appropriate emphasis on safety and risk management (Safety in Design), and according to relevant design standards and requirements. As noted in section 6.4, the detailed design of the proposal would include detailed risk and safety reviews to identify requirements for mitigation to manage and reduce the risk of incidents during operation. The proposal would be designed to comply with appropriate Australian and international standards, to minimise the risk associated with electro-magnetic field exposure.

The operator would be responsible for the safe and efficient operation of the proposal and the safety of customers. The operator would produce a safety management system and a full suite of operational rules, procedures and manuals, describing how the proposal would be operated and maintained. Operation of the proposal would be guided by a comprehensive risk management strategy including standard risk and safety mitigation measures and plans (such as incident and emergency response plans).

Targeted community education programs would be implemented prior to and during operation to build community awareness of the operation of the proposal and the potential for safety risks associated with being in close proximity to light rail vehicles.

15.9.3 Mitigation measures

Detailed design and pre-construction

- The proposal would continue to be designed with adequate consideration given to achieving high levels of safety for customers, employees and the general community.

Construction

- A hazards, risks and contingency management plan would be prepared as part of the CEMP to identify hazards and risks, and measures to minimise risks and respond to incidents during construction. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

Operation

- A targeted community safety campaign would be implemented to raise awareness in relation to the operation of the proposal. The safety campaign, which would be undertaken in the lead up to the opening and during operation, would focus on raising awareness and promoting safe behaviours at stops, in the separated and mixed running areas, and at key crossings.
- The operator's management system would include a comprehensive risk and safety management strategy and incident and emergency response plans.

15.10 Services and utilities

15.10.1 Existing environment

A desktop utility investigation was undertaken as an input to the *Definition Design Report* (PB/Aurecon, 2014b). Key findings are summarised below. Further investigation and consultation would be undertaken during the detailed design stage.

Utilities within the road reserves

Infrastructure and services within and in the vicinity of the proposal site that have been identified are summarised in Table 15.1.

Table 15.1 Infrastructure and services with the potential to be impacted by the proposal

Service type	Provider	Infrastructure
Electrical	Ausgrid	High and low voltage underground and overhead cabling along Stewart Avenue, Beresford Street, Hunter and Scott Streets
	Sydney Trains	11 kV overhead and underground cabling within and adjacent to the former rail corridor
Potable water and wastewater	Hunter Water	Potable and wastewater mains and local supply/drainage
Stormwater	Newcastle Council	Kerbs and gutters, drainage pipelines, stormwater pits
Communications	AAPT, Telstra, Ipera (Vocus), Kloster, Nextgen, Optus, Soul, TPG	Cabling and conduits within streets
Gas	Jemena	Gas mains in the vicinity of Hunter and Scott Streets
Traffic signals	Council and Roads and Maritime	Traffic signals in the median and road reserve at various locations

Utilities within the existing rail corridor

Many of the services associated with the former rail corridor (power, signalling, communications etc.) would be decommissioned and removed prior to the commencement of proposal construction.

15.10.2 Construction impact assessment

The proposal would have the potential to impact on the services and infrastructure listed in Table 15.1, mainly as a result of excavation. All services (including pits and surface features) within and/or crossing the proposal site would need to be relocated and/or protected.

Shallower sewer and drainage pipes and culverts (i.e. gravity flow) may not be able to be relocated due to the limitations of the downstream connection levels and grade requirements and/or heritage protection requirements. In this case, structural protection measures would be implemented.

There may be some short term interruptions to services during construction owing to the need to divert services, however the design of the proposal is being developed to ensure that there is minimal physical impact on adjoining or adjacent infrastructure.

Impacts would be minimised by ensuring that investigations are undertaken by the contractor to locate all underground services in the vicinity of the proposal site prior to construction commencing. Consultation with service providers would also be undertaken to minimise the potential for impacts, coordinate any service relocations, and ensure access to utilities is preserved for any future maintenance activities.

15.10.3 Operation impact assessment

The operation of the proposal would require power to run the light rail vehicles, electrical equipment at the stops, and the stabling and maintenance facility. This would require an additional power supply over the existing amount supplied for the local area.

The proposal includes the installation of two substations to augment the local power systems and provide the power required for the vehicles and stops.

15.10.4 Mitigation measures

Detailed design and pre-construction

- Detailed survey and consultation with service providers would be undertaken to accurately locate services.
- The detailed design of the proposal would seek to minimise the need for service and utility relocations.
- The need for, and proposed relocation of any utilities would be determined in consultation with service providers.

Construction

- A services management plan would be prepared as part of the CEMP to provide specific measures to minimise impacts to services during construction. An outline of the requirements for the CEMP, including a list of management measures to be incorporated, is provided in section 16.3.

15.11 Cumulative impacts

15.11.1 Approach

When the impacts of a project combine with the impacts of other projects, there is the potential for cumulative impacts to result, which may be significant in combination. Such impacts could include the cumulative protection or loss of flora and fauna, an increase or reduction in noise levels, or an increase or reduction in traffic levels and the availability of parking. The nature and scale of any cumulative impact depends upon a number of factors, including the timing and relative scale of impacts arising from various developments, the location of the receiver, the reversibility of any impacts, and the resilience of the receiver or natural resource.

The impact assessment outlined in this section provides a qualitative summary of the potential for cumulative impacts based on a desktop review of potential developments, with the exception of the construction and operational road network performance modelling which already included predictions in relation to future development, employment and traffic growth.

Projects with the potential for cumulative impacts with the proposal were considered to be larger projects/infrastructure developments (excluding construction or alteration of single dwellings) located within about 500 metres of the proposal. These were identified by:

- searching the following registers/databases:
 - Department of Planning and Environment's major projects register
 - NSW Planning Assessment Commission's project register for the Newcastle local government area on 26 March 2015
 - Council's online development application database.
- consulting with relevant government stakeholders including UrbanGrowth NSW
- reviewing the strategies and planning documents outlined in chapter 5.

15.11.2 Projects with the potential for cumulative impacts

Major developments (proposed and underway) in the vicinity of the proposal site are summarised in chapter 14.

There are also a number of other smaller projects (mainly alterations and additions) that may be underway at the same time as the proposal is constructed.

As noted in chapter 5, the proposal is also part of a larger program of urban transformation and transport projects being led by UrbanGrowth NSW.

15.11.3 Construction impact assessment

Potential cumulative impacts could include:

- increased construction traffic
- changes to pedestrian, cyclist and vehicle routes that may require temporary or permanent closure to facilitate the works
- minor changes in local flood risk due to increases in impermeable areas
- changes to the visual character of the proposal site
- increased levels of noise including some works during the evening and night-time periods.

The cumulative impacts that might occur during construction are expected to be temporary and, the majority would occur in the short to medium term.

Potential cumulative impacts with the major developments described in chapter 14 are summarised in Table 15.2.

Table 15.2 Major developments considered for potential cumulative construction impacts

Project	Description	Likelihood of interaction
Newcastle East End/ Hunter Street Mall redevelopment	<p>Construction period: Unknown</p> <p>Construction duration: Unknown</p> <p>Key impacts: Impacts may include construction amenity impacts in the vicinity of the works such as traffic, transport and access disruptions, noise, dust, visual changes, potential built heritage impacts, loss of parking etc. Long term operational impacts would include increased visitation and use of the city centre.</p>	<p>Low – approval, timing and staging of this project is unknown. It is likely that the proposal (if approved) would be completed prior to this project commencing.</p>
Wickham Transport Interchange	<p>Construction period: September 2014 – end 2016</p> <p>Construction duration: 24 months</p> <p>Key impacts: Minor public transport travel time increases during construction, easing of traffic congestion on Stewart Avenue, changes to traffic, transport and access around the new interchange location, loss of about 75 on-street car parks, noise, visual change, socio-economic benefits for Wickham.</p>	<p>High – there will be some overlap of construction periods and concurrent works at the Wickham Transport Interchange in Beresford Street. The potential for cumulative traffic and noise impacts between the proposal and the development of the Wickham Transport Interchange are considered in chapters 8 and 9.</p>
University of Newcastle city campus (NeW Space)	<p>Construction period: April 2014 – end 2016</p> <p>Construction duration: 24 months</p> <p>Key impacts: Noise, traffic, parking and pedestrian disruption, visual changes.</p>	<p>Moderate – concurrent with the proposal with potential increases to peak period traffic volumes, noise and visual change. However impacts from this project are predominantly limited to the site footprint.</p>
Newcastle Courthouse	<p>Construction period: April 2014 – early 2016</p> <p>Construction duration: 24 months</p> <p>Key impacts: Noise, traffic, parking and pedestrian disruption, visual changes.</p>	<p>Low – this project, while directly adjacent to the proposal, will be substantially complete prior to proposal construction (if approved).</p>

In general, sensitive receivers that are most likely to be affected by cumulative impacts would be those that are in close proximity to the construction works and/or vehicle access routes. As potential impacts associated with construction of the proposal would be short term and impacts would be localised, the potential for significant cumulative impacts is considered to be limited.

15.11.4 Operation impact assessment

The NUTTP aims to progress the revitalisation program proposed by the *Newcastle Urban Renewal Strategy* and achieve the revitalisation of the Newcastle city centre. The medium and longer term cumulative benefits of the overall strategy (including the proposal) are expected to include:

- reduced traffic congestion as a result of the removal of a number of railway level crossings between Wickham and Newcastle stations
- increased use of public transport as well as non-vehicular transport modes

- improved access to popular leisure and recreational areas in the city centre, at Honeysuckle, and at Newcastle and Nobbys beaches
- improved transport to make the city centre easier to access and move around in, and better connected to the waterfront
- increased economic activity and output from the Newcastle city centre, including new business and commercial opportunities
- re-establishing Hunter Street as Newcastle's main street and the revitalisation of the Hunter Street Mall and the East End
- improved urban amenity, including changes to the character of existing areas, improving the quality of public spaces and streets, reduced anti-social behaviour, and improved levels of personal safety.

The cumulative benefits of all projects under the NUTTP may take longer to achieve but would also be longer-lasting and would be experienced by a much wider group, including residents, workers and tourists.

15.11.5 Mitigation measures

Detailed design

- The potential for cumulative impacts would be further considered as the proposal methodology develops and as further information regarding the location and timing of other potential developments is released.
- TfNSW would consult with the proponents of other major projects in the area (including internally) to develop strategies to address potential cumulative traffic and transport and noise impacts.

Construction

- Works would be scheduled to minimise the potential for cumulative impacts with any other projects in the surrounding area.

Part D

Environmental management and
conclusion

16. Environmental management

This chapter outlines the environmental management framework that would be implemented during construction and operation of the proposal. In particular, the chapter provides an overview of the scope and contents of the CEMP, and an outline of the approach to environmental management during operation.

16.1 Approach to environmental management

TfNSW's ISO 14001 accredited environmental management system would be used to manage the proposal. The management system would provide the framework for implementing the environmental management measures documented in this REF, and any conditions of other approvals, licences or permits.

A CEMP would be prepared for the construction phase of the proposal. The CEMP would provide a centralised strategy through which all potential environmental impacts would be managed. The CEMP would document processes for demonstrating compliance with the commitments made in this REF, the submissions report (to be prepared), as well as any other relevant statutory approvals. An outline of the required contents of the CEMP is provided in section 16.3.

The CEMP would be prepared by the construction contractor and endorsed by the project Environmental Management Representative (EMR) to the satisfaction of TfNSW.

For the operational phase, environmental issues and impacts would be managed under the Operator's environmental management system as well as through any specific management measures relevant to the operation phase, as summarised in chapter 17.

16.2 Post-determination/pre-construction surveys

If TfNSW determines to proceed with the proposal, the next phase of planning would be the detailed design phase. The detailed design will take into account the findings of the REF and any conditions of the determination. The following plans and surveys would be prepared/undertaken prior to, or as part of, the detailed design:

- Further consideration of operational noise mitigation options as discussed in chapter 9.
- Building condition surveys in accordance with the mitigation measures listed in chapter 9 and in Table 16.1.
- Archaeological surveys in accordance with the recommendations of the Statement of Heritage Impact (refer chapter 10) and the Aboriginal heritage due diligence assessment (refer chapter 11).

16.3 Construction environmental management

16.3.1 CEMP outline

The CEMP would include:

- The proponent's environmental policy, objectives and performance targets for construction and operation.
- Reference to all relevant statutory and other obligations, including consents, licenses, approvals, and voluntary agreements required.

- Management policies, procedures and review processes to assess the implementation of environmental management practices and the environmental performance of the proposal against the objective and targets.
- Requirements and guidelines for management in accordance with:
 - conditions of the determination
 - mitigation measures specified by this REF
 - relevant construction management guidelines (including those listed in Table 16.1).
- Requirements in relation to incorporating environmental protection measures and instructions in all relevant standard operating procedures and emergency response procedures.
- Specific procedures, including monitoring, as defined by this REF and the conditions of the determination.
- Roles and responsibilities of all personnel and contractors to be employed on site.
- Procedures for complaints handling and ongoing communication with the community.
- Monitoring and auditing program.

16.3.2 Sub-plans and general construction management measures

The CEMP would include the sub-plans and general construction management measures listed in Table 16.1.

16.4 Monitoring and compliance

The CEMP and operational environmental management system would specify requirements in relation to ongoing monitoring during construction and operation. Regular auditing of the environmental management plans would be undertaken. In the event of a non-compliance with the management plan, it would be the proponent's responsibility to ensure appropriate investigation, reporting and implementation of corrective actions. In terms of responsibilities:

- TfNSW would be responsible for ensuring that mitigation measures are implemented during construction and operation.
- The construction contractor would be responsible for day-to-day implementation of the requirements of the CEMP, and ensuring that all personnel involved in the implementation of the CEMP are trained in their roles so that they are familiar with practices and procedures.

16.5 Incident and contingency management

Incident management procedures would be developed as part of the CEMP and the operational environmental management system. The procedures would clearly outline the process to be followed in the event of an environmental incident or noncompliance, including:

- classification of the incident based on the severity of the likely impact on the surrounding environment and community
- emergency response procedures
- notification requirements
- mechanisms for improving environmental controls to reduce the likelihood of a similar incident occurring
- incident reporting and tracking.

During construction, the construction contractor/s would be responsible for developing contingency plans to address any environmental impacts arising from lack of effectiveness of the proposed environmental management measures and/or unforeseen events.

During operation, environmental issues and impacts would be managed under the Operator's environmental management system.

Table 16.1 CEMP outline requirements

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>1. General</p>	<p>The CEMP would outline the construction conditions and temporary environmental protection measures to manage the impact of construction activities. It would be consistent with the mitigation and management measures documented in this REF, conditions of the determination, the conditions of any licences or permits issued by government authorities, and TfNSW's ISO 14001 accredited environmental management system.</p>	<p>Site induction</p>	<ul style="list-style-type: none"> • All employees, contractors and subcontractors would receive an environmental induction which would include: <ul style="list-style-type: none"> – all proposal specific and standard noise and vibration mitigation measures – relevant conditions of licences/approvals/determinations etc – permissible hours of work – any limitations on high noise generating activities – location of nearest sensitive receivers – heritage requirements – construction employee parking areas – designated loading/unloading areas and procedures – construction traffic routes – site opening/closing times (including deliveries) – environmental incident procedures.
		<p>Out of hours work</p>	<ul style="list-style-type: none"> • If out of hours works are required, the contractor would prepare and submit a TfNSW Out of Hours Work Assessment (3TP-PR-065) and Application Form (9TP-FT-079) for approval at least 10 days prior to the works being undertaken. All out of hour works and activities would be undertaken with additional mitigation measures in accordance with the <i>Construction Noise Strategy</i> (TfNSW, 2012). • Should an EPL be applicable, the out of hours approvals process under the EPL would replace the above TfNSW process.
		<p>Monitoring and auditing</p>	<ul style="list-style-type: none"> • The CEMP would identify monitoring, auditing and inspection requirements, and determine the framework for the management of key environmental issues for construction.
		<p>Environmental Control Maps</p>	<ul style="list-style-type: none"> • The location of sensitive areas (e.g. heritage items and trees to be retained) would be clearly identified on Environmental Control Maps, which would be supplied to construction managers and workers.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>2. Soil and water</p>	<p>The soil and water management sub-plan would detail how potential impacts on soils, erosion, sedimentation, watercourses and water quality (surface and groundwater) would be mitigated and managed during construction.</p> <p>The plan would provide for incident management in relation to potential water quality contamination incidents.</p> <p>It would include procedures to manage the impact of the proposal on flooding, and would take into account the requirements of relevant guidelines, including:</p> <ul style="list-style-type: none"> • <i>Managing Stormwater: Urban Soils and Construction Vol 1</i> (Landcom, 2004) • <i>Managing Stormwater: Urban Soils and Construction Vol 2A Installation of Services</i> (DECC, 2008) • <i>Technical Guideline: Temporary stormwater drainage for road construction</i> (RMS, 2011) • <i>Acid Sulfate Soil Planning Guidelines</i> (Department of Urban Affairs and Planning, 1998) • <i>Waste Classification Guidelines</i> (EPA, 2014) • <i>Water Discharge and Reuse Guideline</i> (TfNSW, 2015a). 	<p>Water quality/ sediment control</p>	<ul style="list-style-type: none"> • Sediment and erosion control devices would be installed to minimise mobilisation and transport of sediment in accordance with <i>Managing Urban Stormwater, Soils and Construction</i> (Landcom, 2004). • Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and any subsequent records retained. Sediment would be cleared from behind barriers/sand bags on a regular basis as required and all controls would be managed to ensure they work effectively at all times. • Exposed surfaces would be stabilised, and final landscaping implemented, as soon as practicable. • Erosion control devices would be removed as part of the final site clean-up. This would include removing any sediment in drainage lines that has been trapped by erosion control devices, and restoring disturbed areas. • Stockpiles would be managed by implementing sediment and erosion control devices in accordance with <i>Managing Urban Stormwater, Soils and Construction</i> (Landcom, 2004). • Stockpiles would not be located adjacent to existing culverts or drainage lines. • The area of exposed surfaces would be minimised. Disturbed areas would be stabilised progressively to ensure that no areas remain unstable for any extended length of time. • Soil and sediment that accumulates in erosion and sediment control structures would be reused where practicable during site restoration, unless it is contaminated or otherwise inappropriate for reuse. • Work would cease during heavy rainfall events when there is a risk of sediment loss off site or ground disturbance due to waterlogged conditions. • Equipment, plant and materials would be placed in designated lay-down areas where they are least likely to cause erosion.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Spill/incident management	<ul style="list-style-type: none"> • Spill kits would be maintained on-site at all times. • Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking. • Refuelling of plant and equipment would be undertaken within designated areas with appropriate controls. • Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) would be undertaken on a regular basis to identify any potential spills. • Vehicle wash down and/or cement truck washout would occur in a designated bunded area or off-site.
		Groundwater	<ul style="list-style-type: none"> • Groundwater encountered during construction would be managed and disposed of in accordance with the <i>Waste Classification Guidelines</i> (EPA, 2014) and the <i>Water Discharge and Reuse Guideline</i> (TfNSW, 2015a). Groundwater would be managed to ensure it does not cause pollution of waters in accordance with section 120 of the POEO Act. • If dewatering is required during construction, the water would be tested, and treated if necessary, prior to re-use, discharge or disposal in accordance with the testing results.
		Flooding	<ul style="list-style-type: none"> • The existing drainage systems would remain operational during construction. • No stockpiles of materials or storage of fuels or chemicals would be located within high/medium flood risk areas or flow paths. • Where practicable, site offices and facilities would be located above the 100 year ARI flood level. • A flood evacuation plan would be prepared and included in the soil and water management plan.
		Acid sulphate soils	<ul style="list-style-type: none"> • An acid sulphate soils management plan would be developed and implemented in accordance with the <i>Acid Sulfate Soil Planning Guidelines</i> (Department of Urban Affairs and Planning, 1998).

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>3. Contamination and hazardous materials</p>	<p>A contamination and hazardous materials sub-plan would detail how potential and actual contaminated soils and materials would be managed during construction to minimise the potential for significant on and off-site impacts. It would include the listed management measures.</p> <p>Construction hazard and risk issues associated with the use and storage of hazardous materials would be addressed through risk management measures developed in accordance with relevant Department of Planning and Environment guidelines, Australian and ISO standards, and TfNSW's <i>Chemical Storage and Spill Response Guideline</i> (2015).</p> <p>The plan would take into account the requirements of relevant legislation and guidelines, including:</p> <ul style="list-style-type: none"> • POEO Act and the <i>Waste Avoidance and Resource Recovery Act 2001</i> • <i>Waste Classification Guidelines</i> (EPA, 2014) • <i>National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)</i> (NEPM) (National Environment Protection Council, 2013) • <i>Chemical Storage and Spill Response Guidelines</i> (TfNSW, 2015) • WorkCover NSW • Asbestos management guidelines (see below). 	<p>Hazardous materials and incident management</p>	<ul style="list-style-type: none"> • Where there is a potential for the presence of hazardous materials to be disturbed (for example, during removal of the Wickham Station buildings and pedestrian overbridges or excavation of underground services) the works would be monitored by an occupational hygienist. • Any hazardous materials that are to remain on site would be surveyed and recorded on a hazardous building material register. A risk assessment would be undertaken and a management plan implemented, including any remediation measures. The register and management plan would be maintained and updated in accordance with the relevant WorkCover codes of practice. • Where required, any materials classified as Hazardous Waste would be treated, or an immobilisation approval obtained, in accordance with Part 10 of the Protection of the Environment Operations (Waste) Regulation 2014 prior to off-site disposal. • In the event synthetic material fibres are found on site, they would be handled and disposed of in accordance with the National Code of Practice for the Safe Use of Synthetic Mineral Fibres. • All known and presumed occurrences of polychlorinated biphenyls would be handled and disposed of in accordance with the procedure documented within the ANZECC <i>Identification of PCB-containing Capacitors – An information booklet for electricians and electrical contractors 1997</i>. Removal would be undertaken by a suitable licenced hazardous material removal contractor and would be disposed of to a suitably licenced facility. • The storage of hazardous materials, and refuelling/maintenance of construction plant and equipment, would be undertaken in clearly marked designated areas that are designed to contain spills and leaks. • Spill kits, appropriate for the type and volume of hazardous materials stored or in use, would be readily available and accessible to construction workers. • All hazardous materials spills and leaks would be reported to site managers, and actions would be immediately taken to remedy spills and leaks. • Training in the use of spill kits would be given to all personnel involved in the storage, distribution or use of hazardous materials. • Machinery would be checked daily to ensure that no oil, fuel or other liquids are leaking. • Refuelling of plant and equipment would be undertaken within a designated refuelling point.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
	Contamination management measures should be consistent with the findings of the <i>Newcastle Light Rail - Geotechnical and Contamination Investigation Interpretative Report</i> (PB, 2015)		
		Unexpected finds	<ul style="list-style-type: none"> • An 'unexpected finds protocol' would be prepared and included in the CEMP to assist with the identification, reporting, assessment, management, health and safety implications, remediation, and/or disposal (at an appropriately licensed facility) of any potentially contaminated soil and/or water. This would include specifying appropriate reporting requirements in accordance with the EPA's <i>Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997</i> (EPA, 2015). • In the event that indicators of contamination are encountered during construction (such as odours or visually contaminated materials), work in the affected area would cease immediately, and the procedures detailed in the unexpected finds protocol would be implemented. • Work would cease in the vicinity of any potential asbestos materials which have not been previously identified. The material would be analysed for the presence of asbestos. In the event the material is disturbed prior to work ceasing, the provisions of the asbestos management plan would be followed, including seeking advice from a suitably qualified and experienced professional.
		Identified areas of contamination	<p>Measures recommended by the contamination investigation should be implemented, including:</p> <ul style="list-style-type: none"> • Any soil material disturbed in the vicinity of boreholes 7, 9 and 15 would be kept segregated from adjoining soil. • Further testing would be undertaken on any excavated material to be disposed of from these sites. Additional sampling would be undertaken at a density of one sample per every 25 m³ to be disposed of, to potentially reduce the volume of material to be disposed of. • Further health investigation and evaluation is required if material excavated at these locations is to remain on-site.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
	<p>The asbestos management plan would take into account the requirements of relevant legislation and guidelines, including:</p> <ul style="list-style-type: none"> • WorkCover NSW requirements • <i>Waste Classification Guidelines</i> (EPA, 2014) • <i>Draft Protocol for managing asbestos during resource recovery of construction and demolition waste</i> (EPA, 2014) • Guidelines produced by Safe Work Australia, including the <i>Model Codes of Practice – How to Manage and Control Asbestos in the Workplace</i> (Safe Work Australia, 2011) and <i>How to Safely Remove Asbestos</i> (Safe Work Australia, 2011). 	Asbestos	<ul style="list-style-type: none"> • An asbestos management plan would be developed in accordance with relevant guidelines. • Asbestos would be analysed as part of final waste classification for any soil to be excavated for disposal in accordance with the <i>Waste Classification Guidelines</i> (EPA, 2014). • The removal, handling and disposal of any asbestos waste would be undertaken by an appropriately licensed contractor, and in accordance with the model codes of practice produced by Safe Work Australia.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>4. Traffic, transport and access management plan</p>	<p>The traffic, transport and access management sub-plan would detail how traffic, public transport and access would be managed during construction to minimise the potential for significant impacts.</p> <p>It would include measures relating to truck and traffic movements, parking and access requirements for construction personnel, safety signage, and training of personnel in traffic management. It would cover all construction zones and worksites, including the construction compounds.</p> <p>The plan would include the listed management measures and would address the requirements outlined in chapter 8 and Technical Paper 1.</p>	<p>Construction site traffic</p>	<ul style="list-style-type: none"> • Traffic and access would be managed in accordance with <i>Traffic Control at Work Sites</i> (RTA, 2010) and in consultation with Roads and Maritime, and Council. • Adequate road signage would be provided to inform drivers of the work, timing and alternative access arrangements. • Measures to manage traffic flows around the area affected by construction would be provided, including required regulatory and directional signposting, line marking, variable message signs, and all other necessary traffic control devices. • The plan would specify routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses. • Construction vehicles would park within the construction compound where practicable. • The timing of deliveries accessing the site would be programmed to ensure there is sufficient space within the proposal site to accommodate deliveries. • The queuing and idling of construction vehicles in residential streets would be minimised. • Designated queuing and idling areas would be determined near the work site to minimise disruption to the local community. • Adequate sight lines would be provided to allow for safe entry and exit from the construction sites. • Access to all private properties adjacent to the proposal site would be maintained during construction, unless otherwise agreed with relevant property owners. • Co-ordination with other constructors, including those responsible for constructing Wickham Transport Interchange, would be undertaken, particularly regarding works at the Stewart Avenue/Hannell Street intersection. • Ongoing consultation and feedback from key stakeholders including Roads and Maritime and Council would be co-ordinated by TfNSW to facilitate the efficient completion of the works, and ensure awareness of proposed road network or intersection changes, and the efficacy of mitigation proposed. • Contractors, including transport/deliveries contractors, would be provided with a copy of the traffic, transport and access management sub-plan to ensure disruptions to the local community are minimised. • The plan would include specific measures in relation to the key intersections listed in Technical Paper 1.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Pedestrian and cyclists	<ul style="list-style-type: none"> • The plan would include measures to maximise safety and access for pedestrians and cyclists, including details of alternative access arrangements. • Adequate road signage would be provided to inform pedestrians of the work, and ensure that the risk of accidents and disruption to surrounding land uses is minimised. • Adequate road signage would be provided to inform pedestrians and cyclists of the work, timing and alternative access arrangements.
		Taxis and public transport	<ul style="list-style-type: none"> • The plan would include details for the relocation of kiss-and-ride, taxi ranks and bus stops if required, including appropriate signage to direct patrons, in consultation with the relevant operator. • Adequate signage would be provided at all stops along the bus routes to clearly show the location of stops and routes. • Consultation with regional and interstate bus operators would be undertaken to determine their requirements, including any rerouting of services if required.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>5. Noise and vibration</p>	<p>The noise and vibration management sub-plan would detail how potential noise and vibration impacts would be mitigated and managed during construction. The plan would be prepared in accordance with the <i>Construction Noise Strategy</i> (TfNSW, 2012) and would include the listed management measures. Where the noise and vibration levels are predicted to exceed the criteria after implementation of the general work practices, the additional mitigation measures detailed in the <i>Construction Noise Strategy</i> would be implemented.</p> <p>The requirements of relevant standards and guidelines, including AS 2436-2010 and the <i>Interim Construction Noise Guideline</i> (DECC, 2009) would be addressed.</p> <p>The plan would also include reference the complaints management procedures specified in the communication and complaints management plan (refer to item 8).</p>	<p>Notification and behaviour</p>	<ul style="list-style-type: none"> • Notification undertaken during construction would inform relevant stakeholders of the work locations and timing, and the potential for noise impacts. • Construction sites and compounds would be managed to minimise noise generating activities, including unnecessary shouting, loud stereos/radios, dropping of materials from height, throwing of metal items, and slamming of doors, particularly at the start and finish of shifts.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Construction hours and scheduling	<ul style="list-style-type: none"> • Where possible, work generating high noise and/or vibration levels would be undertaken during standard daytime working hours. Work undertaken outside of standard hours would require adequate justification, additional mitigation measures, as detailed in the <i>Construction Noise Strategy</i> (where required), and the application of the out of hours requirements specified under item 1. • For work undertaken in the vicinity of receivers where 'highly noise affected' impacts are predicted: <ul style="list-style-type: none"> – High noise and vibration generating activities would only be carried out in continuous blocks, not exceeding three hours each, with a minimum respite period of one hour between each block. – No more than four consecutive nights of high noise and/or vibration generating work would be undertaken over any seven day period, unless otherwise approved by TfNSW.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Equipment and plant	<ul style="list-style-type: none"> • Quieter and less vibration emitting construction methods would be used where reasonable and feasible. • The noise levels of plant and equipment would have operating sound power or sound pressure levels that comply with the criteria listed in Table 2 of the <i>Construction Noise Strategy</i> (TfNSW, 2012). • Consider solar and/or battery alternatives to generators such as for lighting towers. • Consider the use of noise barriers/blankets to reduce noise impacts to sensitive receivers. • The noise levels of plant and equipment items would be considered in rental decisions. • Simultaneous operation of noisy plant within range of sensitive receivers would be avoided. • The offset distance between noisy plant and adjacent sensitive receivers would be maximised. • Plant used intermittently would be throttled down or shut down. • Noise-emitting plant would be directed away from sensitive receivers. • Non-tonal reversing beepers (or an equivalent mechanism) would be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. • Stationary noise sources (such as pumps, compressors, fans etc) would be enclosed or shielded whilst ensuring that the health and safety of workers is maintained. • Consider site topography when situating plant and use structures (such as site shed placement, earth bunds, fencing, noise barriers) to shield receivers from noise.
		Traffic flow and deliveries	<ul style="list-style-type: none"> • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. • Loading and unloading of materials/deliveries would occur as far as possible from sensitive receivers, and preferably during standard construction hours. • Site access points and roads would be selected to minimise impacts on sensitive receivers. • Dedicated loading/unloading areas would be shielded if they are located close to sensitive receivers. • Where practicable, delivery vehicles would be fitted with straps rather than chains for unloading.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Measuring and monitoring	<ul style="list-style-type: none"> • A noise monitoring program would be developed and implemented in accordance with the <i>Construction Noise Strategy</i> (TfNSW, 2012). • Attended vibration measurements would be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range (specified by Table 9.7) to prevent cosmetic building damage. • Additional vibration and noise monitoring may be required in response to complaints.
		Vibration	<ul style="list-style-type: none"> • Define the construction methods to be used in the vicinity of heritage listed items. • Dilapidation surveys would be undertaken for heritage buildings/structures that may be impacted by the proposal. • Where construction is required within the safe working buffer distance, alternative work methods would be considered, such as the use of smaller equipment. If no alternative work method is feasible or reasonable, then compliance vibration monitoring would be undertaken. • Site tests to review the measured frequency content would be undertaken to refine the structural damage criteria for standard buildings and for heritage structures. • Trial vibration testing would be carried prior to undertaking any high vibration activities. Trials would be undertaken in non-sensitive areas and at a range of distances from the source. The results of the trial monitoring would be compared against predicted vibration levels and the potential for impact refined, if deemed appropriate. • The trial period may also be used to determine the effectiveness of source-based mitigation measures, such as changing the operating speed of the vibratory roller to generate a higher frequency of vibration, which may allow for a higher vibration threshold at the structure. • For identified properties within buffer distances, or where pre-construction monitoring indicates that vibration levels from construction activities would exceed the target levels, a property condition survey of all potentially affected structures would be undertaken to enable post-construction verification that construction activities did not cause existing structural damage. • Continuous vibration monitoring would be undertaken at sensitive receivers within the buffer distances in accordance with <i>Assessing Vibration: a technical guideline</i> (DEC, 2006).

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>6. Heritage (Aboriginal and non-Aboriginal)</p>	<p>The heritage management sub-plan would detail how potential impacts on Aboriginal and non-Aboriginal heritage would be mitigated and managed during construction.</p> <p>The plan would be prepared in consultation with relevant agencies and Aboriginal groups for management of Aboriginal heritage, listed non-Aboriginal heritage items and archaeological areas, and any previously unidentified items/areas of potential heritage significance identified during construction. It would incorporate the results of archaeological subsurface testing and an unexpected finds procedure.</p>	<p>General – built and non-Aboriginal heritage</p>	<ul style="list-style-type: none"> • All heritage items in the immediate vicinity of the proposal site would be marked on Environmental Control Maps, site plans, fenced off where appropriate, and avoided. • The detailed construction methodologies would take into account the heritage significance of the area, the outcomes of testing, and mapped heritage items. Works would be undertaken in a manner that minimises the potential for damage and avoids physical impact on adjacent heritage listed buildings. • Sufficient protection including temporary fencing would be installed around built heritage items where works are to be undertaken in close proximity to these items, or where a thoroughfare or construction access is required. • A heritage induction would be provided to all workers before construction commences informing them of the location of heritage items within the study area, and guidelines to follow if unanticipated heritage items or deposits are located during construction. • Any unforeseen or accidental damage would be made good under the supervision of a qualified engineer with heritage experience following consultation with the TfNSW Project Manager and Environment and Planning Manager (EPM).
		<p>Vibration</p>	<ul style="list-style-type: none"> • The construction noise and vibration management plan (refer item 5) would define the construction methods to be used in the vicinity of heritage listed items and the measures to minimise the likelihood of vibration impacts.
		<p>AHIP</p>	<ul style="list-style-type: none"> • Work would not commence in areas covered by an AHIP until all conditions of the AHIP have been complied with, including any further assessment and/or salvage works required
		<p>Unexpected finds</p>	<ul style="list-style-type: none"> • If previously unidentified Aboriginal or non-Aboriginal heritage/archaeological items or relics are uncovered during construction works, all works in the vicinity of the find shall cease and the TfNSW Project Manager and Environmental Planning Manager would be notified. Appropriate advice would be sought from a suitably qualified heritage consultant/archaeologist (and in consultation with the relevant division of the Department of Planning and Environment, as required). Works in the vicinity of the find shall not re-commence until clearance has been received from the heritage consultant/archaeologist and the TfNSW EPM.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
7. Visual amenity	The visual amenity sub-plan would provide measures to minimise the potential impacts of the proposal during construction.	General worksite management	<ul style="list-style-type: none"> • Work sites would be screened by fencing or placement of hoardings where practicable. Machinery, plant and equipment would be contained within these hoardings where practicable. • Regular maintenance of site hoarding and perimeter site areas would be undertaken, including the prompt removal of graffiti. • Identify opportunities for an artistic approach to treatment of the site hoarding and enclosure, in collaboration with Council. This would include consideration of day and night-time activation of the exterior of the site. • Work sites would be maintained in a clean and tidy condition at all times. • Temporary hoardings, barriers, traffic management and signage would be removed when no longer required. • On completion of construction, all work sites and other land occupied temporarily would be reinstated.
		Site specific requirements	<ul style="list-style-type: none"> • Hoardings would be designed to visually recede into the open space setting around Pacific Park. Hoarding treatments (colours and or materials) that complement the green parkland surroundings would be used. • Position equipment and site access away from Wheeler Place and the Hunter Street Mall as far as practicable.
		Lighting	<ul style="list-style-type: none"> • Directional lighting would be mounted to avoid light spill into adjoining residences. • Lighting would be installed and maintained in accordance with <i>Australian Standard (AS) 4282 Control of the Obtrusive Effects of Outdoor Lighting</i>

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
8. Communication management plan	<p>The communication management sub-plan would provide guidance for the management of communication and consultation during the construction period, including objectives of consultation, stakeholders, contact mechanisms, and protocols.</p> <p>The plan would also include implementation and maintenance of a complaints register and complaints handling and escalation procedures, consistent with TfNSW requirements.</p>		<ul style="list-style-type: none"> • Contact details for a 24-hour project response line and email address would be provided for ongoing stakeholder contact throughout the proposal. • Provision of accurate public information signs while work is in progress. • Staging of works would be undertaken to minimise disruption, in consultation with relevant stakeholder groups, to minimise impacts to community activities and functions. • Complaints would be managed according to TfNSW’s Complaint Management Process. Specifically: <ul style="list-style-type: none"> – Details of all complaints received will be recorded. – A verbal response describing what action will be taken will be provided to the complainant within two hours (unless the complainant agrees otherwise). – A detailed written response will be provided to the complainant within seven calendar days.
9. Vegetation management	<p>The vegetation management sub-plan would detail how vegetation would be protected, and measures to replace any trees needing to be removed. The plan would take into account relevant legislation and guidelines, including:</p> <ul style="list-style-type: none"> • <i>AS 4970-2009 Protection of trees on development sites</i> • <i>Vegetation Management (Protection and Removal) Guideline</i> (TfNSW, 2015c) • <i>Weed Management and Disposal Guide</i> (TfNSW, 2015d) • The urban design and landscaping strategy for the proposal (refer to section 12.4). 	Vegetation management	<ul style="list-style-type: none"> • The CEMP and construction plans would clearly document the location and full extent of any vegetation disturbance required. These areas would be clearly marked to avoid disturbance to adjacent retained vegetation, and exclusion fencing would be installed around trees to be retained. • Any vegetation planted on-site would be consistent with the urban design and landscaping strategy for the proposal, and would consist of locally native species, unless otherwise agreed with TfNSW, following consultation with the Council where relevant.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
		Tree management	<ul style="list-style-type: none"> • The management of trees in the vicinity of the construction zone would be consistent with the <i>AS 4970-2009 Protection of trees on development sites</i> (incorporating Amendment No. 1 (March 2010)). • Tree protection methods would be marked on the Environmental Control Maps. • Any trees proposed for removal would be replaced and/or offset in accordance with TfNSW's <i>Vegetation Offset Guide</i> unless otherwise agreed with or directed by TfNSW. • Approval would be obtained in accordance with TfNSW's <i>Application for Removal or Trimming of Vegetation</i> for the trimming, cutting, pruning or removal of trees or vegetation. • Any tree removal, maintenance and protection work would be undertaken by a qualified arborist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of five years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works. • Tree protection zones and associated controls, including storage and movement restrictions, would be identified and implemented as part of the plan. If works are required within the tree protection zones, they would be restricted to the area outside of the structural root zone to avoid disturbing the stability and health of the trees. • Any root pruning required within the structural root zone would be approved and conducted by the project arborist. Any digging and pruning of roots within the structural root zone would be conducted by hand for a clean cut. Only roots with a diameter of less than five centimetres would be pruned.
		Weed management	<ul style="list-style-type: none"> • Weeds would be managed and disposed of in accordance with the requirements of the <i>Noxious Weeds Act 1993</i> and/or the <i>Weeds of National Significance Weed Management Guide</i>. • Weed control mitigation and management strategies would be documented and implemented in accordance with the <i>Noxious Weeds Act 1993</i> and the <i>Weed Management and Disposal Guide</i> (TfNSW, 2015d). This would include procedures to reduce the spread of weeds via vehicles and machinery, such as visual inspection of vehicles prior to exit from site to ensure they are clear of plant material.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
10. Air and dust	<p>The air and dust management sub-plan would detail how potential impacts on air quality would be mitigated and managed during construction.</p>	<p>Air quality</p>	<ul style="list-style-type: none"> • All plant and machinery would be fitted with emission control devices complying with relevant Australian Standards. • Machinery would be turned off when not in use and not left to idle for prolonged periods. • Vehicle movements would be limited to designated entries and exits, haulage routes, and parking areas. • Dust generation would be monitored visually, and where required, dust control measures such as water spraying would be implemented to control the generation of dust. • Materials transported to and from the site would be covered to reduce dust generation in transit. • Access points would be inspected to determine whether sediment is being transferred to the surrounding road network. If required, sediment would be promptly removed from roads to minimise dust generation. • Stabilisation of any exposed surfaces as soon as practicable, including implementation of final landscaping as early as possible. • Shade cloth would be fastened to the perimeter fence on the proposal site to minimise dust transported from the site during construction. • Daily inspections and regular surveillance would be undertaken to identify any vehicle, plant or equipment that is causing visible emissions. If any defective vehicles, plant or equipment are identified, operation of this machinery would cease and service/maintenance would be undertaken. • Works (including the spraying of paint and other materials) would be suspended during strong winds or in weather conditions where high levels of dust or airborne particulates are likely. • Any exposed surfaces would be stabilised, and final landscaping implemented, as soon as practicable.

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
<p>11. Spoil and waste</p>	<p>The spoil and waste management sub-plan would detail how waste would be managed during construction to minimise the potential for significant impacts.</p> <p>It would include disposal requirements, measures to reduce, re-use or recycle wastes where possible. It would set targets for waste diversion, demonstrate how targets can be achieved, and outline how waste diversion would be tracked and reported.</p> <p>The plan would be prepared in accordance with the <i>Waste Classification Guidelines</i> (EPA, 2014).</p>	<p>Waste management</p>	<ul style="list-style-type: none"> • Resource management hierarchy principles would be followed: <ul style="list-style-type: none"> – avoid unnecessary resource consumption as a priority – avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery) – disposal is undertaken as a last resort. • Waste material, including soil and spoil to be taken off site, would be classified and managed in accordance with the <i>Waste Classification Guidelines</i> (EPA, 2014) and would be disposed of in accordance with the POEO Act. • All waste documentation would be collated and maintained on file in accordance with these guidelines and provided to TfNSW as requested. • Waste material would not to be left on site once the works have been completed. • Working areas would be maintained, kept free of rubbish, and cleaned up at the end of each working day. • At least 90 per cent of construction waste generated during site preparation and construction would be diverted from landfill and either recycled or reused in accordance with TfNSW's Sustainability Targets. • 100 per cent of useable spoil material would be beneficially reused in accordance with TfNSW's Sustainability Targets. • Any waste material identified as being contaminated would be managed in accordance with the <i>Contaminated Land Management Act 1997</i> and other relevant legislation and guidelines. • The removal, handling and disposal of any asbestos containing materials would be undertaken by an appropriately licensed contractor, and in accordance with: <ul style="list-style-type: none"> – <i>Code of Practice for the Safe Removal of Asbestos 2005</i> – <i>Code of Practice for the Management and Control of Asbestos in Workplaces 2005.</i>

Item/sub-plan	What would the plan address?	Issue	Management measures to be included in the CEMP and implemented during construction
12. Hazards, risk and contingency management	<p>The hazards, risk and contingency management sub-plan would be aligned to ISO 4260 and AS/NZS 4360:2004 <i>Risk Management</i>, and would provide a systematic pro-active approach of ongoing risk identification and contingency planning.</p> <p>It would identify hazards and risks, and measures to minimise risks and respond to incidents during construction.</p>		<ul style="list-style-type: none"> • Hazards and risks associated with construction activities would be identified prior to construction. • Management measures for each identified hazard/risk would be developed. • A process for regularly reviewing work practices/procedures would be implemented throughout construction to identify, report, and respond to any new environmental hazards/risks. • Site-specific safety management plans and safe work method statements would be developed and implemented in accordance with work health and safety requirements. • The plan would support the contamination and hazardous materials sub-plan developed as per item 3.
13. Services management	<p>A services management sub-plan would be prepared in consultation with services and utilities providers.</p>		<ul style="list-style-type: none"> • Measures to minimise impacts to services would be developed in consultation with service providers, including: <ul style="list-style-type: none"> – marking services on plans and on-site, and avoiding undertaking works in the vicinity of these services – service relocation and/or interruptions – temporary connections. • Construction planning would take into consideration the potential for impacts on all infrastructure and services. Construction methods would be developed in consultation with service providers, and works would be scheduled to minimise the potential for impacts to or on the use of infrastructure and services. • Relevant stakeholders would be notified regarding service disruptions in accordance with the communication management plan. • Any impacts to infrastructure and services would be made good by the contractor at the completion of works. • Work being undertaken on or around infrastructure would be clearly signposted and appropriately fenced.

17. Summary of mitigation measures

This chapter provides a compilation of the proposal specific mitigation measures that would be implemented during design, construction and operation, based on the findings of the impact assessment provided in chapters 8 to 15.

17.1 Proposal specific mitigation measures

Table 17.1, Table 17.2 and Table 17.3 provide a summary of the measures proposed to mitigate and manage the potential impacts of the proposal, as detailed in chapters 8 to 15.

The measures listed may be revised in response to submissions raised during public display of the REF and/or any design changes made following public display. TfNSW would consider the final environmental management commitments when making a determination on the proposal. Following determination, the finalised mitigation measures would guide subsequent phases of the proposal. The construction contractor would be required to undertake all works in accordance with these measures.

Table 17.1 Proposal specific mitigation measures – detailed design/pre-construction

No.	Issue	Mitigation measure
Detailed design/pre-construction		
1	Traffic, transport and access	
1.1	<i>Parking and loading zones</i>	<ul style="list-style-type: none"> A parking strategy would be prepared prior to construction to review options to mitigate the loss of on-street parking and loading zones. The review would include both existing on-street and off-street parking locations as well as the opportunities provided by new or proposed developments or Government-owned land close to the proposal site. The review would: <ul style="list-style-type: none"> be undertaken in accordance with the objectives and requirements of the Newcastle Urban Renewal Strategy and the NUTTP, and relevant transport and parking strategies and policies involve an audit of the use of existing spaces including turnover include an assessment of the potential options and identification of a preferred option/s. be undertaken in consultation with relevant stakeholders, including surrounding businesses/organisations and Council.
1.2	<i>Cycleways</i>	<ul style="list-style-type: none"> A cycleway strategy would be prepared prior to construction to review options available to support the provision of a dedicated east–west cycleway, potentially replacing the existing cycleway along King Street. The review would include assessment of potential options and identification of a preferred option/s, and would be undertaken in consultation with relevant stakeholders, including Council, Roads and Maritime and local cyclist groups.
1.3	<i>Other road works</i>	<ul style="list-style-type: none"> The agreed package of measures to complement the introduction of the proposal; remove existing pinch points in the road network; and ensure traffic continues to move freely and efficiently during construction and operation, would be determined in consultation with Council.
2	Noise and vibration	
2.1	<i>Reasonable and feasible noise mitigation</i>	<ul style="list-style-type: none"> The predicted noise and vibration levels, and the required noise and vibration mitigation measures, would be confirmed during the detailed design phase. Reasonable and feasible mitigation would be implemented to reduce exceedances associated with the operation of the proposal.
2.2		<ul style="list-style-type: none"> Further design work and iterative noise modelling would be undertaken as the design progresses to identify reasonable and feasible mitigation

No.	Issue	Mitigation measure
		measures for operational noise. This would involve consideration of the measures summarised in Table 9.11. The final form of the mitigation measures would be determined during detailed design.
2.3		<ul style="list-style-type: none"> Where exceedances of other non-residential sensitive receiver noise levels have been predicted, this would be verified in the detailed design stage, including further investigation of the façade performance of these receivers.
2.4	<i>Track design</i>	<ul style="list-style-type: none"> The final track design and associated operational groundborne noise and vibration mitigation measures would be addressed in the detailed design of the track. More detailed investigations would be conducted including measurement of existing internal and external noise and vibration levels, including groundborne noise and vibration levels due to the existing road traffic. These investigations would inform the required design in these locations and confirm the appropriateness of the groundborne operational noise design goals.
2.5	<i>Stabling and maintenance facility</i>	<ul style="list-style-type: none"> Further design work and iterative noise modelling would be undertaken as the design progresses to identify reasonable and feasible mitigation measures that would reduce exceedances from stationary noise sources including from the stabling and maintenance facility. The design of the stabling and maintenance facility and associated mechanical equipment would include noise mitigation measures (as required) to comply with the <i>Industrial Noise Policy</i> (EPA, 2000) criteria at the nearest noise sensitive receivers. This would involve consideration of the measures summarised in Table 9.12. The final form of the mitigation measures would be determined during detailed design.
2.6	<i>Substations</i>	<ul style="list-style-type: none"> The operational noise from the substations would be controlled by inclusion of appropriate mitigation, such as shielding or enclosures, and specification of equipment selection, to comply with the <i>Industrial Noise Policy</i> at all locations.
2.7	<i>PA systems</i>	<ul style="list-style-type: none"> The detailed design of public address systems at the light rail stops would include noise mitigation measures to minimise potential noise impacts at the nearest receptors to the stops to comply with the <i>Industrial Noise Policy</i> at all locations.
3	Heritage	
3.1	<i>Non-Aboriginal heritage - general</i>	<ul style="list-style-type: none"> Detailed design of the proposal would be sympathetic to the surrounding heritage items/elements and the significance of the Newcastle City Centre Heritage Conservation Area.
3.2	<i>Archaeological areas</i>	<ul style="list-style-type: none"> Pre-construction requirements in relation to the archaeological areas are provided in Table 10.3.
3.3	<i>Heritage approvals and notification</i>	<ul style="list-style-type: none"> Consultation would be undertaken with Council in accordance with the requirements of clause 14 of the Infrastructure SEPP in relation to the removal of Wickham Station.
3.4		<ul style="list-style-type: none"> The Heritage Division would be informed in writing at least 14 days before removal of the buildings associated with Wickham Station.
3.5		<ul style="list-style-type: none"> The Statement of Heritage Impact would be provided to Sydney Trains in relation to potential impacts on the items listed on their section 170 register.
3.6		<ul style="list-style-type: none"> An exception application would be made and approval received under section 139(4) of the <i>Heritage Act 1977</i> prior to construction in archaeological areas 1 and 4 (exception type S139(1C)) and 2, 3 and 5 (exception type S139(1B)).
3.7		<ul style="list-style-type: none"> Approval would be sought under section 140 of the <i>Heritage Act 1977</i> to impact on the footings of the former Honeysuckle Station in archaeological area 3. Approval would be received prior to any excavation work commencing in this area.
3.8	<i>Wickham Station</i>	<ul style="list-style-type: none"> Full archival recording of Wickham Station and the associated buildings would be undertaken prior to removal of any structures.

No.	Issue	Mitigation measure
3.9		<ul style="list-style-type: none"> A heritage interpretation plan would be developed, consistent with <i>Interpreting Heritage Places and Items Guidelines</i> (NSW Heritage Office, 2005) to provide the strategies for communicating information on the history of the station.
3.10		<ul style="list-style-type: none"> Materials salvaged from the structures would be reused where appropriate in accordance with the heritage interpretation plan.
3.11	<i>Aboriginal heritage approvals</i>	<ul style="list-style-type: none"> An application for an AHIP would be made under section 90A of the <i>National Parks and Wildlife Act 1974</i>. The AHIP would be sought for the land and associated objects within the boundaries of the proposal site and specified Aboriginal sites and objects contained within the listed sites. The AHIP would be prepared and submitted in consultation with relevant Aboriginal stakeholders, as required under the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010). This consultation has commenced.
3.12		<ul style="list-style-type: none"> The AHIP would include mitigation by performing archaeological salvage for nominated sites. Archaeological salvage would be completed prior to any activities which may harm Aboriginal objects at these locations. The archaeological salvage activities would be undertaken in accordance with the methodology developed in consultation with Aboriginal stakeholders.
4	Landscape character and visual	
4.1	<i>Urban design</i>	<ul style="list-style-type: none"> The detailed design of all structures would involve consideration of appropriate design features, materials and treatments to ensure that the proposal: <ul style="list-style-type: none"> integrates with the surrounding and proposed urban form achieves the urban design objectives of the <i>Newcastle Urban Renewal Strategy</i>, the NUTTP and <i>Newcastle 2030</i> minimises the potential for visual impacts respects the character and amenity of the surrounding area.
4.2	<i>Urban design and landscaping strategy</i>	<ul style="list-style-type: none"> An urban design and landscaping strategy would be prepared as part of the detailed design. The strategy would consider: <ul style="list-style-type: none"> Use of a high quality landscape buffers (with street trees and planting) where practicable along the corridor to help integrate the infrastructure with the context and improve the visual experience of passengers. The design of the landscape buffers would be undertaken in consultation with Council and other stakeholders. Strategic use of materials that blend, enhance and/or complement existing surfaces and improve visual coherence of the proposal and its context. Options to help make the overhead wire/catenary system appear as an integrated part of the public domain. The opportunity to combine several above-ground street elements (lighting, traffic signals etc.) on common use poles to reduce visual clutter. The use of materials, finishes, colour schemes and maintenance procedures including graffiti control for new walls, barriers and fences. Strategic location of signage to maintain sensitive sight lines and avoid unnecessary intrusion into receptors' views, and to enhance legibility of the broader context. The design of barriers (railings, fences or walls) required for safety to complement the existing visual environment. The heritage significance of the Newcastle City Centre Heritage Conservation Area. The <i>NSW Sustainable Design Guidelines</i> (TfNSW, 2014a). Safety and security requirements, including crime prevention through environmental design (CPTED) requirements.

No.	Issue	Mitigation measure
4.3	<i>Lighting</i>	<ul style="list-style-type: none"> Lighting for the proposal would be designed in accordance with <i>AS 4282 Control of the Obtrusive Effects of Outdoor Lighting</i>. Lighting would be designed to minimise light spill into adjoining areas.
4.4	<i>Community involvement</i>	<ul style="list-style-type: none"> Opportunities for community involvement in mitigating visual impacts during construction and operation would be explored in consultation with Council.
4.5	<i>Design review</i>	<ul style="list-style-type: none"> TfNSW's Sustainable Design Review Panel would review the detailed design.
5	Socio-economic	
5.1	<i>Parking</i>	<ul style="list-style-type: none"> Options to mitigate the reduction in availability of on-street parking and loading zones would be considered as detailed in section 8.4. Consideration of the options would include a review of opportunities to retain on-street disabled parking and/or prioritise parking for the disabled.
5.2	<i>Business and organisation management plan</i>	<ul style="list-style-type: none"> A business and organisation management plan would be developed by TfNSW in consultation with affected stakeholders to understand and manage impacts to businesses and organisations in the vicinity of the proposal. The plan would: <ul style="list-style-type: none"> – address construction and operation – be developed in consultation with the Council, businesses, and local organisations and service providers – take into account other developments and proposals in the city centre – include access management plans which would establish existing servicing and delivery requirements and identify alternative routes and requirements – identify strategies to maintain emergency access at all times – take into account special events planned in and around the city centre during the construction period.
5.3	<i>Consultation</i>	<ul style="list-style-type: none"> As described in section 4.5, key stakeholders (including local businesses and the community) would continue to be consulted regarding the potential impacts of the proposal. Where practicable, measures to address these impacts would be incorporated into the design.
5.4		<ul style="list-style-type: none"> TfNSW would continue to work with relevant stakeholders including Council to identify opportunities to integrate the design of the proposal with other city centre renewal activities, to improve access to local community services, and further enhance the public domain along the proposal site.
5.5	<i>CPTED</i>	<ul style="list-style-type: none"> The detailed design of the proposal would take into account CPTED principles, particularly in relation to the stops and the stabling and maintenance facility. The design would incorporate features to maintain the safety of passengers, employees and the general public. Stops would be designed to be safe and attractive places to wait for services and would (where feasible and appropriate) incorporate LED lighting technology, emergency calling capabilities and CCTV.
5.6	<i>Local employment opportunities</i>	<ul style="list-style-type: none"> Partnership opportunities would be investigated with local employment agencies to identify opportunities to generate local employment benefits consistent with the <i>NSW Sustainable Design Guidelines</i> (TfNSW, 2014).
6	Land use and property	
6.1	<i>Consistency with the NUTTP</i>	<ul style="list-style-type: none"> TfNSW would consult with key stakeholders as outlined in chapter 4 to ensure the proposal continues to be designed to achieve consistency with the initiatives proposed by the <i>Newcastle Urban Renewal Strategy</i> and the NUTTP.
6.2	<i>Acquisitions</i>	<ul style="list-style-type: none"> All acquisitions would be undertaken in consultation with landowners and in accordance with the requirements of the Crown Lands Act 1989 and the Land Acquisition (Just Terms Compensation) Act 1991.

No.	Issue	Mitigation measure
7	Hydrology and water quality	
7.1	<i>Water quality</i>	<ul style="list-style-type: none"> The proposal would be designed to ensure there is minimal potential for water quality impacts as a result of the operation of the proposal. Bunding would be incorporated into the design to contain any chemical spills or leaks from the stabling and maintenance facility and substation sites.
7.2	<i>Flooding</i>	<ul style="list-style-type: none"> The proposal would be designed to ensure compliance with the <i>Floodplain Development Manual</i> (DIPNR, 2005) which includes a requirement to not increase flood levels above existing levels.
7.3	<i>Drainage</i>	<ul style="list-style-type: none"> All track drainage would be designed to meet relevant TfNSW standards and the requirements of Australian Rainfall and Runoff (Engineers Australia, 1999).
8	Geology and soils	
8.1	<i>Mine subsidence</i>	<ul style="list-style-type: none"> Further geotechnical assessment would be undertaken during detailed design to confirm and assess the location and condition of former mine workings and sub-grade conditions.
8.2		<ul style="list-style-type: none"> Those aspects of the proposal located within the Newcastle Mine Subsidence District would be designed in accordance with any requirements provided by the Mine Subsidence Board.
9	Services and utilities	
9.1	<i>Impacts to services and utilities</i>	<ul style="list-style-type: none"> Detailed survey and consultation with service providers would be undertaken to accurately locate services.
9.2		<ul style="list-style-type: none"> The detailed design of the proposal would seek to minimise the need for service and utility relocations.
9.3		<ul style="list-style-type: none"> The need for, and proposed relocation of any utilities would be determined in consultation with service providers.
10	Waste and resources	
10.1	<i>Waste and resources</i>	<ul style="list-style-type: none"> Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.
11	Sustainability and climate change	
11.1	<i>Sustainability</i>	<ul style="list-style-type: none"> Design of the proposal would be undertaken in accordance with the <i>NSW Sustainable Design Guidelines</i> (V3.0, TfNSW, 2014). Initiatives recommended by the sustainability assessment to achieve a rating level of 'gold' would be implemented.
11.2		<ul style="list-style-type: none"> The detailed design of the proposal would aim to achieve an 'excellent' rating using the ISCA infrastructure sustainability rating tool.
11.3		<ul style="list-style-type: none"> The feasibility of using renewable energy for the proposal would be investigated.
11.4		<ul style="list-style-type: none"> The sustainability initiatives would be regularly reviewed, updated and implemented throughout the design development phases.
11.5		<ul style="list-style-type: none"> The feasibility of using grassed tracks along sections of the alignment would be investigated.
11.6	<i>Climate change</i>	<ul style="list-style-type: none"> A climate change risk assessment would be developed during detailed design
11.7		<ul style="list-style-type: none"> A carbon foot printing exercise, compliant with ISO 14064 Part 2 (Greenhouse gases – project level), would be undertaken in accordance with TfNSW's Carbon and Energy Reporting Tool and the <i>NSW Sustainable Design Guidelines</i>. The carbon footprint would be used to inform decision-making in design and construction. Standard carbon coefficient values would be used for construction material and fuel usage.

No.	Issue	Mitigation measure
11.8	<i>Greenhouse gases</i>	<ul style="list-style-type: none"> Opportunities to reduce operational greenhouse gas emissions would be investigated during detailed design. These would include the initiatives documented in the sustainability assessment.
11.9		<ul style="list-style-type: none"> The feasibility of using renewable energy for the construction of the proposal would be investigated.
12	Hazards and risks	
12.1	<i>Safety</i>	<ul style="list-style-type: none"> The proposal would continue to be designed with adequate consideration given to achieving high levels of safety for customers, employees and the general community.
13	Cumulative impacts	
13.1	<i>Cumulative impacts</i>	<ul style="list-style-type: none"> The potential for cumulative impacts would be further considered as the proposal methodology develops and as further information regarding the location and timing of other potential developments is released.
13.2	<i>Consultation</i>	<ul style="list-style-type: none"> TfNSW would consult with the proponents of other major projects in the area (including internally) to develop strategies to address potential cumulative traffic and transport and noise impacts.

Table 17.2 Construction mitigation measures

No.	Issue	Mitigation measure
B. Construction		
1	Environmental management	
1.1	<i>CEMP</i>	<ul style="list-style-type: none"> A CEMP would be prepared and implemented as described in chapter 16. The CEMP would include the sub-plans and measures detailed in Table 16.1.
2	Heritage	
2.1	<i>Non-Aboriginal heritage</i>	<ul style="list-style-type: none"> Requirements in relation to construction in each of the archaeological areas are provided in Table 10.3.
3	Traffic and transport	
3.1	<i>Consultation</i>	<ul style="list-style-type: none"> Consultation with relevant stakeholders would be undertaken regularly to facilitate the efficient delivery of the works and to minimise congestion and inconvenience to road users. Stakeholders would include contractors on adjacent work sites (particularly the Wickham Transport Interchange) and others such as Council, bus operators, Roads and Maritime, emergency services, affected businesses, and other relevant organisations (such as the University of Newcastle and major employers in the city centre).
4	Noise and vibration	
4.1	<i>Additional mitigation measures</i>	<ul style="list-style-type: none"> Where noise and vibration criteria are predicted to be exceeded, mitigation measures documented in the <i>Construction Noise Strategy</i> (TfNSW, 2012) would be adopted where feasible and reasonable, as specified in Technical Paper 2. Where noise and/or vibration levels are predicted to exceed acceptable levels after implementation of the standard mitigation measures specified by the noise and vibration management plan, the relevant additional mitigation measures detailed in the <i>Construction Noise Strategy</i> would be considered.
4.2	<i>Working hours</i>	<ul style="list-style-type: none"> Where possible, work generating high noise and/or vibration levels would be undertaken during standard daytime working hours. Work undertaken outside of standard hours would require adequate justification and would typically require additional mitigation measures in accordance with the <i>Construction Noise Strategy</i> (TfNSW, 2012).

No.	Issue	Mitigation measure
4.3		<ul style="list-style-type: none"> If out of hours works are required, the procedures outlined in Table 16.1 would be implemented.
5	Socio-economic impacts	
5.1	Access	<ul style="list-style-type: none"> Access to local businesses, community services and social infrastructure would be maintained during construction in accordance with the business and organisation management plan (prepared prior to construction). Where alternative access arrangements need to be made, these would be developed in consultation with relevant service providers, and communicated to businesses and service users.
6	Other issues	
6.1	Hydrology, water quality and groundwater	<ul style="list-style-type: none"> Road and rail stormwater drainage would be reinstated as required, in accordance with Council and/or Roads and Maritime requirements.
6.2	Sustainability and climate change	<ul style="list-style-type: none"> Construction of the proposal would be undertaken in accordance with the <i>NSW Sustainable Design Guidelines</i>. The sustainability initiatives would be regularly reviewed, updated and implemented throughout the construction program.
6.3		<ul style="list-style-type: none"> Regular sustainability reporting (and corrective action where necessary) would be undertaken during construction to demonstrate how sustainability has been incorporated
6.4	Cumulative impacts	<ul style="list-style-type: none"> Works would be scheduled to minimise the potential for cumulative impacts with other projects in the surrounding area.

Table 17.3 Proposal specific mitigation measures – operation

No.	Issue	Mitigation measure
C. Operation		
1	Noise and vibration	
1.1	Operational management procedures	<ul style="list-style-type: none"> The following would be included in the Operator's environmental management procedures: <ul style="list-style-type: none"> Transformers, rectifiers and other electrical equipment on site would be well maintained and operated according to specifications. Operational noise monitoring would be undertaken at regular periods to assess compliance against operational noise criteria listed in Table 9.4 If the results of monitoring indicate that operational noise levels are significantly higher than those modelled for the REF, options to mitigate the noise impacts would be investigated. Maintenance operations would be scheduled during the day. Any noise complaints would be managed in accordance with TfNSW's complaints management procedure.
2	Visual amenity	
2.1	Maintenance	<ul style="list-style-type: none"> Ongoing maintenance, service and infrastructure upgrades would consider the urban design objectives of the <i>Newcastle Urban Renewal Strategy</i> and the NUTTP, where relevant.
3	Socio-economic impacts	
3.1	Communication	<ul style="list-style-type: none"> An operations communication plan would be designed and implemented prior to the commencement of operation to provide information about light rail operation. Information would be made available at each stop and key locations in the city centre, and would also be made available in languages other than English.

No.	Issue	Mitigation measure
4	Other issues	
4.1	<i>Hydrology, water quality and groundwater</i>	<ul style="list-style-type: none"> Operational protocols would be developed by the operator to ensure customer safety and protect infrastructure and light rail vehicles in the event of flooding.
4.2	<i>Erosion</i>	<ul style="list-style-type: none"> During any maintenance work where soils are exposed, sediment and erosion control devices would be installed in accordance with <i>Managing Urban Stormwater: Soils and Construction</i> (Landcom, 2004).
4.3	<i>Contamination and hazardous materials</i>	<ul style="list-style-type: none"> The proposal would be managed in accordance with the operator's environmental management system. The operator's environmental management procedures would include hazardous materials handling and management procedures to minimise the potential for impacts associated with any chemical spills and leaks. These would include procedures for managing spills, and the refuelling and maintenance of vehicles/equipment. These procedures would adequately address activities at the stabling and maintenance facility, as well as other general maintenance of infrastructure associated with the proposal.
4.4	<i>Flora and fauna</i>	<ul style="list-style-type: none"> Operational procedures would be developed to manage any offset plantings, if required.
4.5	<i>Air quality</i>	<ul style="list-style-type: none"> All light rail vehicles would be regularly maintained to ensure efficient operation. Street sweeping of the alignment would be undertaken regularly and in the event of any excessive build-up of material. Maintenance service vehicles and equipment would be maintained and operated in accordance with the manufacturers requirements.
4.6	<i>Waste and resources</i>	<ul style="list-style-type: none"> The proposal would be managed in accordance with the operator's environmental management system and the Waste Classification Guidelines (EPA, 2014).
4.7	<i>Sustainability and climate change</i>	<ul style="list-style-type: none"> The sustainability initiatives would be regularly reviewed, updated and implemented throughout operation.
4.8		<ul style="list-style-type: none"> TfNSW would aim to offset 100 per cent of operational electricity emissions through the purchase of accredited renewable energy suppliers.
4.9	<i>Hazards and risks/safety</i>	<ul style="list-style-type: none"> A targeted community safety campaign would be implemented to raise awareness in relation to the operation of the proposal. The safety campaign, which would be undertaken in the lead up to the opening and during operation, would focus on raising awareness and promoting safe behaviours at stops, in the separated and mixed running areas, and at key crossings.
4.10		<ul style="list-style-type: none"> The operator's management system would include a comprehensive safety management strategy and incident and emergency response plans.

18. Conclusion

18.1 Justification of the proposal

The NSW Government is revitalising the Newcastle city centre. The revitalisation will reinforce the city's role as a 21st century regional centre, unlock the potential of the city centre as a place that can meet the needs of the current and future community, and boost economic activity across the Hunter Region.

A number of strategic planning strategies have considered the need to transform and revitalise Newcastle's city centre over the next 25 years, to respond to the projected growth, and address the issues identified. The key issues and requirements for undertaking urban renewal and transformation projects in the city centre have been considered by a number of planning studies and reports, including the *Newcastle Urban Renewal Strategy*.

The NUTTP has been established to deliver the NSW Government's commitment to revitalise the city. The \$510 million program aims to bring people back to the city centre by strengthening connections between the city and the waterfront, creating employment opportunities, providing more public space and amenity, and delivering better transport.

The transport program aspects of the NUTTP are an important part of the wider renewal of the Newcastle city centre. The removal of the rail line from the city centre, the construction of the Wickham Transport Interchange, and the introduction of light rail, will reconnect the Newcastle CBD to its waterfront and make it easier to move around the city centre. The transport program aspects of the NUTTP will drive the economic growth and renewal of Newcastle as part of an integrated land use and transport strategy.

The proposal is needed to proceed with the revitalisation program proposed by the *Newcastle Urban Renewal Strategy* and the NUTTP. It would also enable the key recommendations of the other relevant strategies and plans to be achieved.

The proposal would support urban renewal, consolidation and development in the key areas laid out in the *Newcastle Urban Renewal Strategy*. The introduction of light rail would facilitate the revitalisation and redevelopment of the Newcastle city centre to boost economic activity and reinforce the city's role as a key regional centre in NSW. The proposal, together with the NUTTP projects, would increase liveability and amenity, and support community objectives.

18.1.1 Benefits of the proposal

The proposal would:

- provide a viable alternative to cars for short trips
- provide regular, efficient and low emitting public transport
- support investment and development – bringing more jobs, residents and visitors into the city centre
- integrate easily with existing traffic and pedestrian spaces
- promote development around an emerging business district at Wickham
- support the growth of residential communities in the Newcastle city centre
- be fully accessible for people with a disability, elderly people and prams.

International studies have shown that light rail is a preferable mode in which to move public transport users within an inner city environment. Light rail is reliable, timely, less likely to be affected by traffic, and provides a smoother more comfortable ride for passengers.

18.2 Summary of REF findings

18.2.1 Clause 228 considerations

Clause 228 of the Regulation specifies the matters that must be taken into account when assessing the likely impact of an activity on the environment for the purposes of Part 5 of the EP&A Act. The potential impacts of the proposal have been considered in chapters 8 to 15 of the REF. The clause 228 matters and how they relate to the proposal are considered in Appendix B.

18.2.2 Ecologically sustainable development

TfNSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of sustainable development. These principles would be incorporated into the management systems for the proposal. A sustainability assessment of the proposal against the *NSW Sustainable Design Guidelines* (TfNSW, 2014a) was undertaken as outlined in section 15.8. Section 6.4.2 details how ecologically sustainable development considerations have informed the design of the proposal. Appendix B summarises how the principles of ecologically sustainable development adopted by the EP&A Act have been addressed by the REF process.

18.3 Conclusion

Environmental investigations were undertaken during preparation of the REF to assess the potential environmental impacts. With the conclusion of ongoing investigations and the implementation of the proposed mitigation measures, there are considered to be no significant environmental issues associated with the proposal. The main potential impacts that would require further consideration during the detailed design process, and management during construction and operation, are summarised below.

- **Transport and access** – The proposal would require the removal of on-street parking spaces and loading zones along the proposal site. Options to address city centre parking requirements would be developed in consultation with relevant agencies and stakeholders, including Council and local businesses.
- **Noise and vibration** – Operation of the proposal has the potential to impact nearby sensitive receivers. There are a number of design approaches and mitigation options which can be implemented to minimise the potential impacts. Feasible and reasonable mitigation measures would be considered during the detailed design process.
- **Heritage** – Measures to minimise the potential for impacts to heritage items would be implemented prior to and during construction. Construction planning would consider measures to protect listed heritage items and archaeological areas located within and adjoining the proposal site.
- **Urban design and visual impacts** – The design of the key features of the proposal (particularly the stops) provides an opportunity to reinforce the role of the proposal in the city centre planning and development process. The design would continue to be refined during future design phases. The final design would continue to take into account relevant considerations, including urban design, heritage and visual impacts.
- **Social and amenity impacts** – Amenity impacts during construction and operation, including traffic, noise and air quality impacts, and the potential for impacts on businesses, would be managed through the implementation of the measures listed in section 13.4. This would include developing and implementing a business and organisation management plan in consultation with affected stakeholders to better

understand and manage impacts to businesses and organisations in the vicinity of the proposal during construction.

Potential impacts resulting from the proposal are considered manageable through the implementation of the proposed mitigation measures.

The detailed design for the proposal is being carefully developed with the objective of minimising potential impacts on the local environment, particularly impacts to traffic and transport; heritage items; other infrastructure in the vicinity of the proposal; and residents, businesses and visitors. The design and construction methodology would continue to be developed with this overriding objective in mind, taking into account the input of stakeholders.

In conclusion, the proposal is needed to enable the urban renewal of Newcastle's city centre. With the implementation of the proposed mitigation and management measures the potential environmental impacts of the proposal would be adequately managed. Having regard to the provisions of section 111 of the EP&A Act, the likely impacts of the proposal (after mitigation) are not likely to be significant and an environmental impact statement is not required.

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Appendices

Appendix A Strategic review and planning context for the proposal

Strategic context for the proposal

A summary of the planning reports and strategies that are relevant to the need for and development of the proposal is provided below.

State and regional planning

State Priorities: NSW Making it Happen

On 14 September 2015 the NSW Premier announced 30 priorities for the state to grow the economy, deliver infrastructure, protect the vulnerable, and improve health, education and public services across NSW. These consist of 12 'Premier's Priorities' and 18 'State Priorities'. Collectively, these replace NSW 2021 as the new state plan.

The priority relevant to the proposal is the Premier's Priority, Building Infrastructure – 'Key infrastructure projects to be delivered on time and on budget across the state'. The proposal is one of the listed key infrastructure projects, with a stated delivery time by end 2019.

Investment in the revitalisation of Newcastle was a key part of the 2013/14 and 2014/15 State Budgets.

NSW Long Term Transport Master Plan

The NSW Government released the *NSW Long Term Transport Master Plan* (TfNSW, 2012) on 13 December 2012. The master plan sets the direction for Transport in NSW for the next 20 years, bringing together all modes of transport across all regions of the state into a world class, integrated network that puts the customer first.

The plan notes the following challenges for Newcastle that are relevant to the proposal:

- planning for and managing strong demand for car travel and solutions for the low levels of public transport use
- addressing the declining or static levels of bus use
- developing an urban renewal program that creates an attractive, accessible city centre
- providing better public transport connectivity across the city, between modes, and to major service centres.

The master plan includes the following actions that are relevant to the proposal:

- strengthen bus operations in the region's major centres
- increase the proportion of commuter trips on public transport to the Newcastle city centre.

The master plan also recognises the links with the *Newcastle Urban Renewal Strategy*, by stating that 'the Department of Planning and Infrastructure is preparing a land use plan for Newcastle and the Hunter which will assess the rail corridor as part of the future transport solutions to support renewal in the Newcastle city centre.'

Hunter Regional Transport Plan

The Hunter Regional Transport Plan was released in April 2014 to support the *NSW Long Term Transport Master Plan* (TfNSW, 2012). The plan identifies a range of short, medium and long term actions to deliver key transport and infrastructure projects to the Hunter region.

Key relevant actions include:

- deliver public transport improvements
- improve public transport interchanges

- transform transport in the CBD.

In relation to the action proposing to transform transport in the CBD, the plan notes that light rail in Newcastle will support the city's renewal, and will include public domain improvements to enhance connections between the city centre and the waterfront.

Regional planning for the Lower Hunter

The *Lower Hunter Regional Strategy 2006-2031* was released by the NSW Government in 2006. The strategy established a 25-year planning framework to guide the growth and spatial development of the Lower Hunter region. The strategy has a particular focus on increasing the supply of housing, particularly affordable housing, in the region. It also aims to maintain the Lower Hunter region's economic growth and prosperity, while simultaneously protecting areas of conservation significance.

A comprehensive review of the strategy commenced in 2011, and a revised regional strategy is currently being prepared. The discussion paper for the new strategy, *The Lower Hunter over the next 20 years: A Discussion Paper* (NSW Government, 2013) was released in March 2013. The discussion paper notes that the decision to replace train services with bus services from a new transport interchange at Wickham will support urban renewal in the CBD by encouraging new development and enhancing physical and visual connections between the city centre and the waterfront. The discussion paper also commits to ensuring that the rest of the city centre is still well serviced by public transport.

The draft revised regional strategy (*Draft Hunter Regional Plan*) and the companion document (*Draft Plan for Growing Hunter City*) (the draft plan) were released for consultation in November 2015 (NSW Government, 2015).

Hunter City is defined in the draft plan as extending from Toronto and Swansea in the south to Raymond Terrace in the north and from Newcastle harbour in the east to Lochinvar in the west. The plan aims to capitalise on existing assets and to leverage greater economic and jobs growth, more housing, and better environmental protection within the city.

The following directions within the draft plan are relevant to the proposal:

- enhance city-wide transport
- coordinate infrastructure to support and deliver growth
- grow and diversify strategic centres in Inner Newcastle
- build on the quality of the inner-city lifestyle.

The draft plan states that:

- 'Significant NSW Government investment in light rail, the Wickham Interchange, a new courthouse, upgrades to John Hunter Hospital services and the completion of the Newcastle Bypass will transform Inner Newcastle and expand its role as a major location for employment and services within the region.'
- 'The NSW Government is investigating options to introduce light rail services to Newcastle. The preferred route, announced in May 2014, will link the Wickham Transport Interchange with Pacific Park, activating Hunter and Scott Streets to support the broader vision for revitalising Newcastle City Centre.'

Local strategies

Newcastle Urban Renewal Strategy

The Department of Planning and Infrastructure released the *Newcastle Urban Renewal Strategy* for public comment in December 2012. The strategy considers the suitability of the Newcastle city centre for urban renewal. It outlines an overall strategy underpinned by a range of initiatives and an implementation plan to support the revitalisation of Newcastle over the next 25 years.

The strategy proposes a framework for the city to grow and identifies initiatives to improve the city's economy, access, connections and the quality and attractiveness of the public domain, all of which are catalysts for encouraging development. The strategy was prepared in accordance with clause 9(2) of *State Environmental Planning Policy (Urban Renewal) 2010* (the Urban Renewal SEPP).

An update of the strategy was released during July 2014, to coincide with the approval of updated planning controls for Newcastle city centre. *State Environmental Planning Policy Amendment (Newcastle City Centre) 2014* amended the city centre controls set out in the Newcastle LEP. It also amended the Urban Renewal SEPP so that the Newcastle city centre area is no longer a potential precinct under the SEPP.

The strategy establishes a framework within which urban renewal of the city centre will be implemented. It seeks to achieve better connections and access to and within the city centre, to support urban renewal.

It defines three distinct precincts in the city centre - the East End, Civic and West End - each with their own distinct character and function:

- East End – a new entertainment destination
- Civic – a new innovation and education destination
- West End – a new central business district, with an employment and events focus.

The updated strategy identifies the following key initiatives:

- urban renewal initiatives:
 - long term growth in the West End
 - promote the city centre as an educational hub
 - strengthen the Civic precinct
 - revitalise Hunter Street Mall
 - recognise Newcastle's heritage
- transport initiatives:
 - manage demand for car parking
 - create a connected walking and cycling network
 - implement the light rail project
 - connect the city with its waterfront
 - re-establish Hunter Street as Newcastle's main street
 - improve the efficiency of the road network for all users.

Newcastle Urban Transformation and Transport Program (NUTTP)

The NUTTP is being driven by UrbanGrowth NSW. It aims to deliver 1,600 new homes and 4,000 new jobs over the next 10 years, to stimulate positive economic growth and renewal of the city centre in the longer term.

The projects to be delivered include those identified by the *Newcastle Urban Renewal Strategy*. Government investment will be focused in the East End and Civic precincts. It will be coordinated with other NSW Government investments with the potential for urban transformation outcomes, including the NeW Space (University of Newcastle city campus), the Law Courts and East End (Hunter Street Mall) developments.

The NUTTP will invest in initiatives that unlock private sector investment including mixed-use development, the establishment of new entertainment and tourism attractions, and the revitalisation of the city's public domain.

The NUTTP is underpinned by the following urban transformation objectives that have been developed in consultation with the community:

- bring people back to the city centre
- reconnect the city to its waterfront
- help grow new jobs in the city centre
- create great places linked to new transport
- create economically sustainable public domain and community assets
- preserve and enhance the city centre's heritage and culture.

Newcastle 2030 (Newcastle Community Strategic Plan)

Newcastle 2030 (City of Newcastle, 2013) is a shared community vision developed as a guide to inform policies and actions throughout the local government area. It identifies 23 objectives to be achieved in the next 10 years across seven key strategic directions. Although the proposal is not mentioned in the strategy, it would arguably have a role in achieving four of these directions:

- a connected city
- vibrant and activated public places
- a liveable and distinctive built environment
- a smart and innovative city

Newcastle CBD Visitor Economy Masterplan

The masterplan was produced by Newcastle City Council, in partnership with the Newcastle Tourism Industry Group, industry operators, and businesses and BIAs, and released in April 2015. It recognises the role of light rail in the potential for transformation section, noting that 'The NSW Government is introducing light rail to Newcastle as part of a strategy to revitalise the city centre, boost economic activity and reinforce the city's role as a 21st century regional centre.'

The masterplan notes that light rail would

- significantly improve connectivity across the city centre, seamlessly linking city assets and precincts
- act as a catalyst project and enabler for the CBD economy precincts of honeysuckle, west end, Hamilton,
- together with a range of other key programs, shape the future economic development of Newcastle.

Hunter Street Revitalisation Strategy

The *Hunter Street Revitalisation Final Strategic Framework* was released by Newcastle City Council in December 2010 to address issues associated with the demise of Hunter Street from its previous role as a major retail and community destination. The strategy provides an integrated planning approach to revitalise Hunter Street, according to four themes: enterprise; integrated transport; people and place; and greenways. The strategy included consideration of the role of light rail in the preferred revitalisation outcomes for Hunter Street.

The priorities identified by the strategy that are relevant to the proposal include:

- develop Hunter Street as the primary multimodal transport corridor for the city centre
- improve the public transport experience by upgrading the bus stops and or incorporating Hunter Street as part of a light rail or tram system servicing the city centre.

Appendix B Consideration of clause 228 factors and ESD

Table A.1 Clause 228 considerations

Clause 228 factor	Summary of results	Potential impact
(a) Any environmental impact on a community	<p>The proposal has the potential to result in amenity related impacts in the vicinity of the works during construction. These impacts would be managed through the implementation of appropriate measures in the CEMP.</p> <p>The main potential for long-term environmental impacts on a community relate to noise associated with operation. These potential impacts would need to be mitigated during the detailed design phase.</p>	<p>Short-term – amenity impacts to be managed by the CEMP</p> <p>Long-term – noise to be mitigated by the design of the proposal</p>
(b) Any transformation of a locality	The proposal would be predominantly located on transport infrastructure zoned land in an area in which rail infrastructure and roads are already located. It would not result in the transformation of this locality.	None
(c) Any environmental impact on the ecosystems of the locality	No environmental impact on ecosystems has been predicted.	None
(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	The proposal would not result in any reduction of these qualities or values.	None
(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations	<p>The proposal would require the removal of the locally listed Wickham Station. The proposal site also crosses a number of archaeologically sensitive areas which would need to be managed in accordance with the mitigation measures.</p> <p>The proposal site is located in the vicinity of a number of heritage items. The main potential for impacts during construction would be as a result of vibration impacts, which would be managed through the implementation of appropriate measures in the CEMP.</p> <p>Measures are provided to mitigate the potential heritage impacts. The design of the proposal would take into account the heritage significance of the study area, and the location of the proposal site in the Newcastle Heritage Conservation Area. No long-term impacts on heritage are predicted.</p>	<p>Short-term – vibration impacts to be managed by the CEMP, potential for other impacts to be managed by the implementation of mitigation measures.</p> <p>Long-term – none</p>
(f) Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)	No impacts on protected fauna within the meaning of the <i>National Parks and Wildlife Act 1974</i> are predicted.	None
(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	The proposal would not endanger any species of plant, animal or other form of life.	None
(h) Any long-term effects on the environment	Other than the introduction of new structures in the landscape, the proposal would not have any long-term impacts on the environment. Potential noise impacts are considered under (a) above.	None

Clause 228 factor	Summary of results	Potential impact
(i) Any degradation of the quality of the environment	The proposal has the potential to result in minor impacts to environmental quality during the construction period. These impacts would be managed through the implementation of mitigation measures. No long-term impacts to the quality of the environment are predicted. Potential noise impacts are considered under (a) above.	Short-term – minor negative Long-term – none
(j) Any risk to the safety of the environment	The construction of the proposal is not considered to result in any risk to the safety of the environment. Safety in the vicinity of the proposal site would be managed by the construction contractor(s). Safety has also been considered throughout the design development.	None
(k) Any reduction in the range of beneficial uses of the environment	The proposal would not result in any reduction in the range of beneficial uses of the environment.	None
(l) Any pollution of the environment	The proposal has the potential to result in minor short-term erosion and air quality impacts during construction. These impacts would be managed through the implementation of the proposal environmental management plan. Operation of the proposal would not produce any additional emissions and no long-term pollution impacts are predicted	Short-term – minor negative Long-term – none
(m) Any environmental problems associated with the disposal of waste	Waste created during construction would be removed from site and recycled where possible.	None
(n) Any increased demands on resources (natural or otherwise) that are, or are likely to become in short supply	The proposal would not increase the demand on any resources that are or are likely to become in short supply.	None
(o) Any cumulative environmental effect with other existing or likely future activities	Construction of the proposal would need to be managed to ensure that the potential for cumulative impacts with other NUTTP projects, particularly the construction of the Wickham Transport Interchange, is minimised.	Short-term – potential impacts to be managed by the CEMP, and in consultation with relevant agencies with respect to other NUTTP projects. Long-term – none
(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions	Coastal inundation associated with king tides and coastal processes occurs to a limited degree around Maryville, Wickham, Stockton and Carrington. Although the Newcastle city centre (including the proposal site) is largely protected from coastal inundation, the combination of heavy rainfall events and high coastal water can exacerbate flood levels.	Long term - flooding to be considered in the design of the proposal

Table A.2 ESD factors

Principle	Definition	Comment
Precautionary principle	This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.	<p>A range of environmental assessments have been undertaken during the preparation of this REF to ensure that the potential environmental impacts can be understood with a high degree of certainty. There are not considered to be any threats of serious or irreversible environmental damage.</p> <p>The proposal has evolved to avoid environmental impact where possible and mitigation measures would be implemented to minimise impacts. No mitigation measures have been deferred due to a lack of scientific certainty. The proposal is therefore considered to be consistent with the precautionary principle.</p>
Intergenerational equity	The principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. In other words, we should ensure that future generations do not inherit a degraded environment.	The proposal site has been previously disturbed during development of the rail and road corridors. The proposal would not result in any impacts that are likely to impact on the health, diversity or productivity of the environment for future generations.
Conservation of biological diversity and ecological integrity	This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.	The study area is located in a modified urban environment. No potential impacts to biological diversity and ecological integrity were identified.
Improved valuation, pricing and incentive mechanisms	This principle requires that 'costs to the environment should be factored into the economic costs of a project'.	<p>The cost of environmental resources includes the costs incurred to protect the environment. The mitigation measures imposed to minimise the adverse impacts of this proposal would result in economic costs to the construction and operation of the proposal. This indicates the valuation of environmental resources has been assigned.</p> <p>The proposal has been designed to minimise adverse impacts on the environment by confining work to a defined area and implementing appropriate mitigation measures when impacts are expected.</p>

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